ESTUARINE HABITAT MAPPING IN THE DERWENT – 2007
A Resurvey of Marine Habitats by SeaMap Tasmania

V.L Lucieer, M. Lawler, M. Morffew and A. Pender

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Summary

The Derwent Estuary is a large drowned river valley situated in south-east Tasmania that extends for a distance of 52 kilometres and covers an area of around 195 km^2 between Iron Pot and New Norfolk. The physical structure of the estuary varies substantially along its length, with the upper reaches highly stratified due to consistent freshwater input from the Derwent River and the lower reaches generally well mixed. The freshwater tends to flow on the surface along the eastern shore with saline water travelling upstream on the bottom.

In 2001 the Derwent Estuary was first mapped by SeaMap Tasmania (Marine Research Laboratories, Tasmanian Aquaculture and Fisheries Institute). This year (2007), TAFI along with the Derwent Estuary Program (DEP) initiated a remap of the Derwent Estuary to update the bathymetric and habitat distribution GIS databases.

The Derwent Estuary Program is committed to improving the environmental management strategy for the Derwent Estuary, together with an associated long-term monitoring program and agreements for implementation of specific environmental improvement programs. The results of this co funded survey provide natural resource managers, industry and the community with the information needed to contribute to biodiversity conservation and natural resource management of the Derwent Estuary.

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1. Introduction

The distribution of the Derwent Estuary's sub-tidal habitats between Iron Pot and New Norfolk were remapped between April and June 2007 in a study initiated by the Derwent Estuary Program. This report details marine habitats that were identified through field mapping using a combination of an echo-sounder and video assessment. Habitats were classified into several categories that generally represent seagrass, consolidated habitat and unconsolidated habitats. A number of video transects were also conducted across different habitats in order to describe the dominant flora.

The estuary was classified and analysed in three sections, identified as the lower, middle and upper reaches, due to differences in the physical aspects of shoreline morphology, bathymetry and salinity. Rocky reef habitats occurred primarily in the lower reaches of the Derwent Estuary, although some narrow margins of reef were also present in the middle reaches. The structure of the macroalgae assemblages that occurred on these reefs varied substantially between eastern and western shorelines, position along the estuary and depth consistent with the results of the initial survey in 2001 (Jordan et al, 2001). In general, the habitat was dominated in the shallow depths by *Lessonia corrugata* and *Ecklonia radiata* while *Carpoglossum confluens*, *E. radiata*, *Caulerpa* sp., and unidentified red algae dominated the deeper section. Parts of the reef along the western shoreline also had a canopy *Macrocystis pyrifera*. The introduced algae *Undaria pinnatifida* also occurred in small amounts on the western shoreline between Tinderbox and the Alum Cliffs (Edgar 1997). The diversity and abundance of macroalgae decreased in the northern part of the lower reaches, with only small amounts of red and brown algae present on the rocky substrates within the middle reaches.

Seagrass habitats were restricted to small beds within the lower (Halfmoon Bay and Opossum Bay) and middle parts (Cornelian Bay, Wilkinsons Point, Dogshear Point, Woodville Bay and Old Beach) of the Derwent Estuary that had a combined area of around 0.17 km^2. The beds consist primarily of *Heterozostera tasmanica*, although small amounts of *Zostera muelleri* were present on the inner margin of beds in the middle reaches. No beds of seagrass were found in either the northern or southern end of Ralphs Bay. The survey of 2001 was conducted in early winter and so it was not possible to compare to the results of this study (2007) which was conducted in early Autumn.

Aquatic macrophytes occurred in large beds in the northern part of the middle section and southern part of the upper section of the Derwent Estuary. In the middle section, extensive beds occurred in the mouth of the Jordan River, southern side of the channel at Granton and northern side of the channel adjacent to Woods Point, usually from the shoreline to around 3 m deep. These beds had a combined area of around 2.5 km^2, with *Ruppia megacarpa* the dominant component, and smaller amounts of *Heterozostera tasmanica*. *Ruppia megacarpa* is able to tolerate the wide range of salinities (Edgar 1997) which occur in this middle and upper section of the Derwent River estuary. The density of *Ruppia* was high and evenly distributed across the beds in all areas, with often a large biomass of filamentous algae also present in the beds.

Unvegetated habitats were the most dominant habitat type within the Derwent Estuary representing around 40 % of all sub tidal habitats, although large differences occurred in the distribution of sediment type between the lower, middle and upper reaches. The lower reaches were represented by sand all depth zones in the mouth, the northern and southern parts of Ralphs Bay and in shallow depths on both eastern and western shores. Silt and sand occurred in the deeper section from around Halfmoon Bay to Gellibrand Point and the northern end of Ralphs Bay and in middle depths on the western shore from Cartwright Point to Sullivans Cove. On the eastern shore north of Droughty Point, sand/silt occurred adjacent to the sand beach habitats up to Kangaroo Bluff. The silt habitat occurred in the deeper parts of the lower reaches north of Gellibrand Point.

The middle reaches of the estuary was dominated by silt habitat, although areas of sand occurred in shallow depths on the western shore up to Cornelian Bay and the eastern shore almost continuously up to Woodville Bay. A large area was also present between Dogshear Point and the eastern shoreline. Silt was restricted to several small areas including Elwick Bay and east of Dogshear Point. The channel region of the upper reaches was found to contain mostly silt, which also dominated the deeper sections.

Approximately 70 introduced and cryptogenic species have been identified from within the Derwent River estuary (Aquenal 200, 2002). Several of these species have broad distributions within the lower and middle reaches of the river, including the introduced marine algae *Undaria pinnatifida*, the seastars *Asterias amurensis*, and *Patiriella regularis*, the screwshell *Maoriculpus roseus*, the Pacific oyster *Crassostrea gigas*, and the fan worm *Myxicola infundibulu* (Morrice 1995, Coughanowr 1997, Macleod and Helidoniotis 2005). Information on the distribution of these species was collected through these surveys.

The main objectives of this survey were to:

- Provide detailed marine habitat maps at 1:12,500 scale of the Derwent Estuary from New Norfolk to the Iron Pot.

- Compile a spatial database (GIS) for all the seagrass and adjacent habitat types and publish the maps on the Land Information System Tasmania (LIST) web mapping site and the SeaMap Tasmania website (http://www.utas.edu.au/tafi/SeaMap/).

- To provide crucial information to the Derwent Estuary Program to assist in the establishment of a database for decision-making

The outputs of the survey include:

- The production of 1:12,500 marine habitat maps in the identified areas published in hardcopy and on the Internet.

- Production of an internal report to the Derwent Estuary Program, detailing the biological and physical structure within the mapping areas and the extent of

key habitat types (spatial statistics from the GIS).

- Generation of a CD with *Image Mapper* software for viewing video linked to habitat maps and representative images and statistics of biological communities (Appendix 3)

The results of this study contribute to the SeaMap Tasmania (TAFI) database providing natural resource managers, industry and the community with up to date information on the distribution and extent of marine habitats in Tasmanian waters.

2. Methods

Information on the distribution of benthic habitats in this report was colleted through acoustic surveys, underwater video and visual observations. A review of the aerial photographs in DPIW's archives for the period 2001-2007 did not present any photographs that were very useful to the delineation of marine habitat boundaries. This was either due to the scale of the photograph or due to the suspended matter in the water column making the differentiation of habitat types difficult. Field ground-truthing and survey work involved a series of transects perpendicular to the coast at distances no greater than 200 m apart. The final maps were produced based on the field data to determine the most likely position of habitat boundaries. To determine the correlation of physical data to the biotic component of habitat type, regular video transects were conducted perpendicular to the coast, and biotic elements and physical variables recorded.

2.1 Acoustic Data Collection

Habitat boundaries were identified from 0-45 m using a Simrad ES60 acoustic echo sounder and video surveys. A series of parallel transects were conducted along the coastline spaced approximately 200 m apart. The echo sounder was set to ping every 0.5 seconds, with a pulse length of 0.256 ms and a power setting of 100 W. The output from the echo sounder along with positional information from an OmniLite132 differential GPS unit was logged using the Simrad ES60 software (v.1.5.2.76 Kongsberg, Simrad).

The logged sounder output was imported into EchoView 3.30 (SonarData) for classification. Different benthic substrates were determined based on changes in the thickness and intensity of the echo sounder output. Harder substrates, which reflect more acoustic energy, appear with a stronger second echo, while rougher substrates, which scatter more of the acoustic energy, appear with a longer tail on the first echo. Seagrass could also be distinguished based on the presence of acoustic reflectance above the sounder detected bottom. These acoustically different echo returns were related back to substrate type based on ground truth information collected by underwater video. The echo sounder output was visually classified as per the classifications detailed in Table 1.

Field data was sampled at fixed time intervals adhering to a "zigzag" pattern of transects perpendicular to the coast (Figure 1). These transects were run at 200 m intervals along the coastline, or more frequently where habitats changed rapidly or had patchy distributions. ArcPad 6.0 was employed in the field to display previous transects and help maintain a regular field-sampling regime.

2.2 Bathymetry

Bathymetric data was recorded by the ES60 echo sounder. Logged data files were imported into EchoView 3.30 where the sounder detected bottom was checked for anomalies, corrected for the transducer depth and exported as a comma delimited text file containing depth and position.

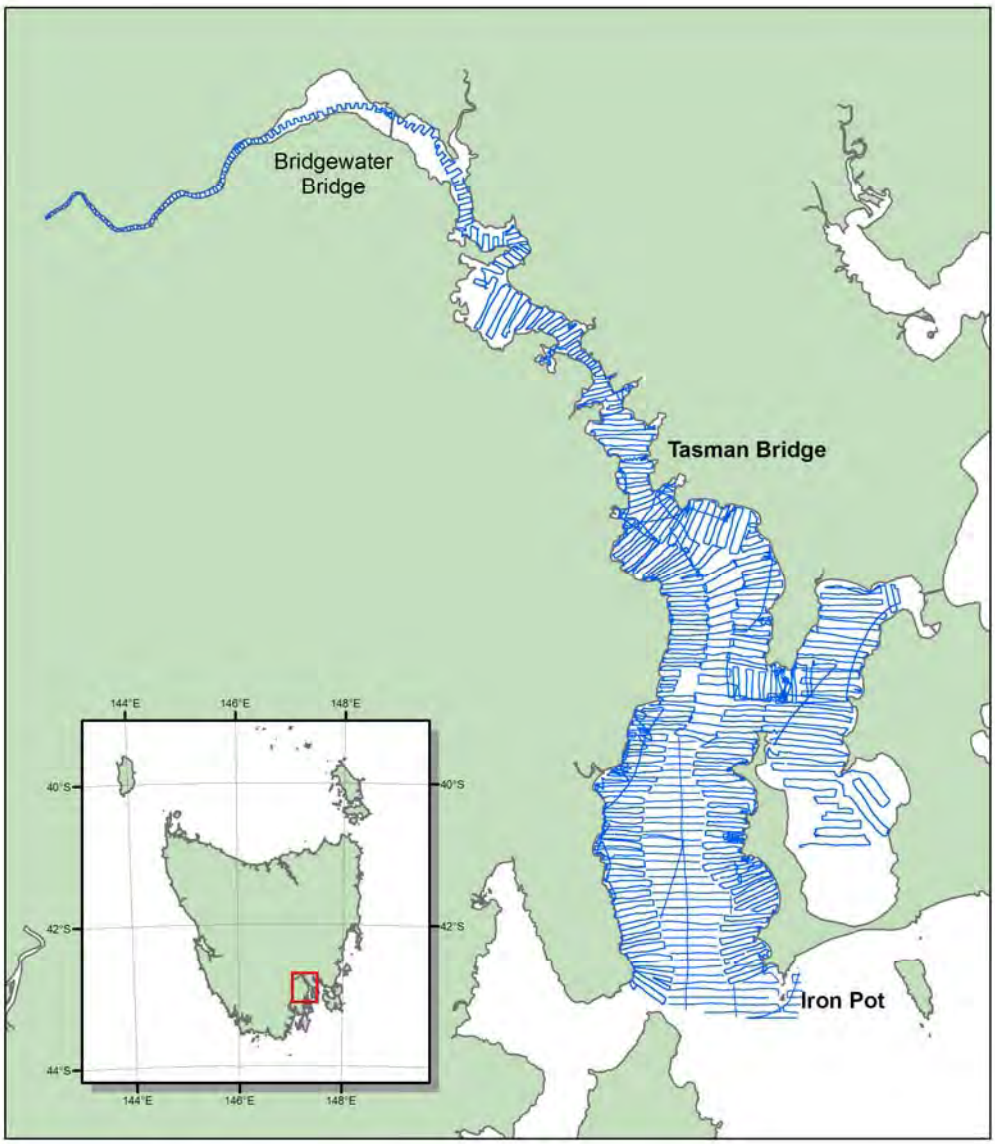


Figure 1. Acoustic transects sampled from the Iron Pot to New Norfolk.

2.2.1 Tidal correction of bathymetric data

Depth measurements from the Simrad ES60 were tidally corrected. These depths were corrected for tidal variation based on the predicted tide heights from the National Tidal Facility (http://www.bom.gov.au/oceanography/tides/). The tidal cycle can be described by a harmonic equation:

$$D_i = D[h_1+(h_2-h_1)*(\cos(\pi*((t-t_1)/(t_2-t_1)+1))+1)/2]$$

Where D_i is corrected depth and D is measured depth, $h_{1,2}$ correspond to the heights of the high and low tides, $t_{1,2}$ are the times of the high and low tides with t being the current time. This formula calculates the height of the tidal cycle for a given time and a given location and then applies this as a correction to the measured field data. All depth measures were corrected to Mean Sea Level based on the available standard port measurements.

2.2.1 Bathymetric contour generation

A depth surface was generated from the field-collected data through the interpolation of depth (*z*) values. Interpolation is the procedure of predicting the values of attributes at unsampled sites from measurements made at point locations within the same area or region (Burrough and McDonnell, 1998). This transformation is based on the Triangular Irregular Network (TIN) data model. Contours in ArcGIS 9.2 were created by interpolating the point data into a TIN, then to create a smooth contour set the TIN was converted to a 5m grid and a 5x5 mean focal filter applied to the grid. The contour coverage provides another source of information from which the habitat polygons can be verified against, especially for seagrass, which has a maximum growth limitation. The contour intervals were generated at 5 m, 10 m, 20 m, 30 m, 40 m, and 50 m.

2.3 Video Data Collection

A submersible digital video camera, MorphCam (MorphVision, NSW, Australia) was deployed at selected locations throughout the study region (Figure 2). This was used to verify the echo sounder substrate classification and obtain more detailed information on algal distribution. Positional information was recorded for each video drop as a series of GPS co-ordinates and also as a direct overlay of the GPS output (position, date and time) onto the video. The video was analysed for dominant flora and fauna for each habitat type. Algae and seagrasses were identified to the lowest taxonomic level possible, For many of the large brown algae, identification could be done to species level, where as red algae were only able to be identified as a group due to a combination of the resolution of the video and the general difficulty in identifying red algae (Fuhrer 1988). Appendix 1 and 2 detail the video analysis by site.

2.4 Cartography

The classified data files from Echo View 3.30 were imported into ArcGIS 9.1 as point data and were used to generate shapefiles of the different habitat types by on-screen digitising. At the 1:2,000 scale, the points were carefully connected to form polygons of similar habitat type. The underwater video documentation was used to help verify the habitat type and the interface between different substrates. The classification table followed for the mapping of habitats on this section of coast is shown in Table 1.

Reef
 REEF The term “reef” applied to any consolidated substrate, though typically consists of rocky outcroppings. It may be of any profile or rugosity.
 COBBLE This definition referred to a hard bottom type consisting of boulders and smaller rocks. This category was usually found in the main channel areas with high flow rates, either tidal or fluvial and occasionally overlapped with the hard sand categories.
Unconsolidated Substrates
SAND Sand was the most commonly encountered unconsolidated substrate. It represents the coarser end of a scale of sediments from silt to sand, though was mostly found to be fine sand.
SILT Silt substrate was only found in the deepest and largest central basins. This habitat category represents the finest unconsolidated substrate. Silt is characterised on the sounder by a lack of a second echo and often little scatter in the trace tail.
Vegetated unconsolidated substrate
 SEAGRASS The “seagrass” category referred to the ‘dense’ areas of seagrass where the substrate, usually sand, was completely covered by seagrass and the patch size is greater than 20 m wide. The dominant seagrass type mapped in the region was *Heterozostera tasmanica*. The habitat mapping presented here, details the extent of the larger beds of this species.
AQUACTIC MACROPHYTES This category covers all the vegetated areas that are either unclear as to their specific habitat type, or are a habitat type that is not being mapped for this project. Almost all of the “vegetated” category mapped for this project consisted of saltmarsh within the intertidal zone within section A of the estuary.
 VEGETATED The term “vegetated” habitat referred to areas of dense vegetation that included seagrasses and other aquatic macrophytes that were so densely mixed it was difficult to map them as separate classes. In the case of the Derwent this included the seagrass species *Heterozostera tasmanica* and *Ruppia megacarpa*.

Table 1. Habitat classes identified within the Derwent Estuary in 2007.

Appendix 3 contains the habitat maps linked with the video file footage in Image Mapper for further display, query and analysis. Appendix 4 contains the ESRI shapefiles of the marine habitats and contours for the exclusive use of the Derwent Estuary Program.

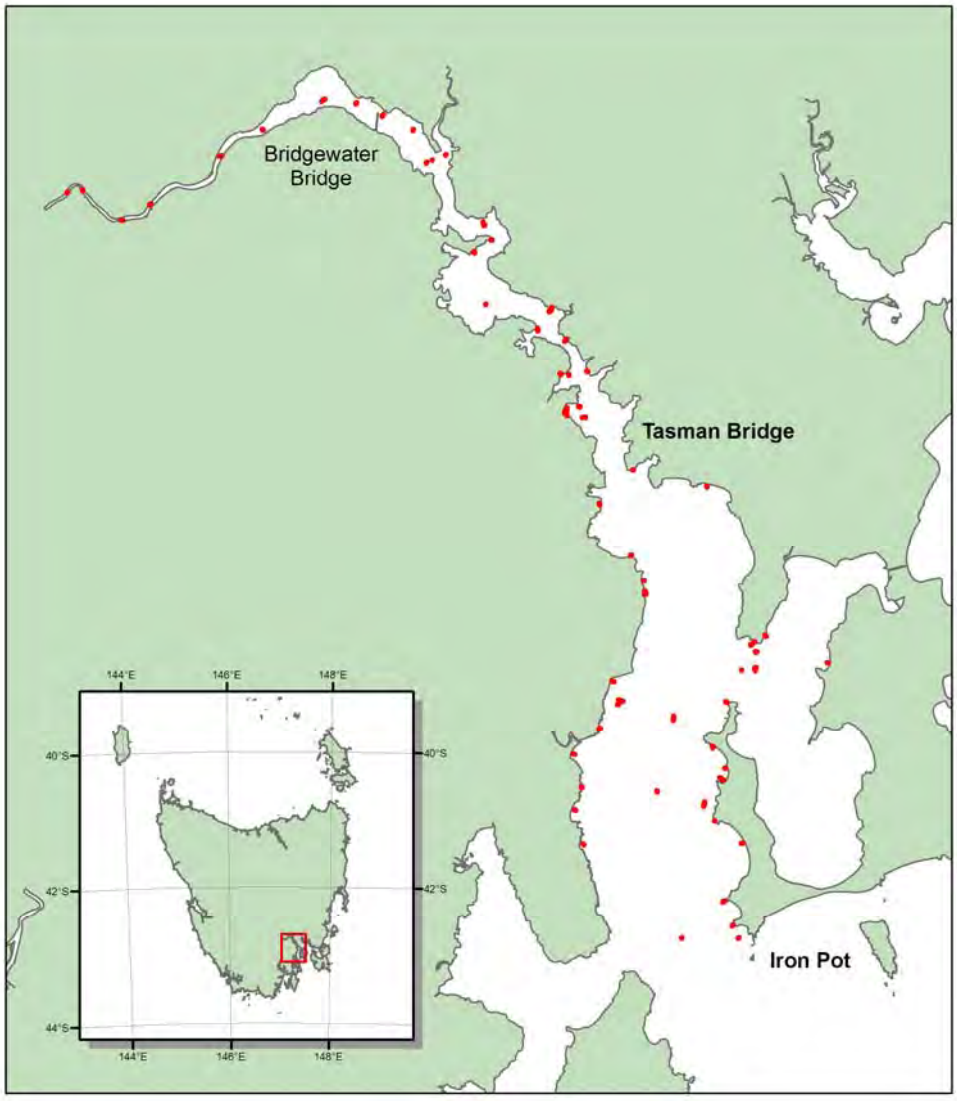


Figure 2. Video transect points collected within the Derwent Estuary in 2007.

3. Results

For this report, the results and analysis have been divided into three reporting sections as shown in Figure 3. A table detailing the extent of each habitat type is presented for each of these areas in the following section.

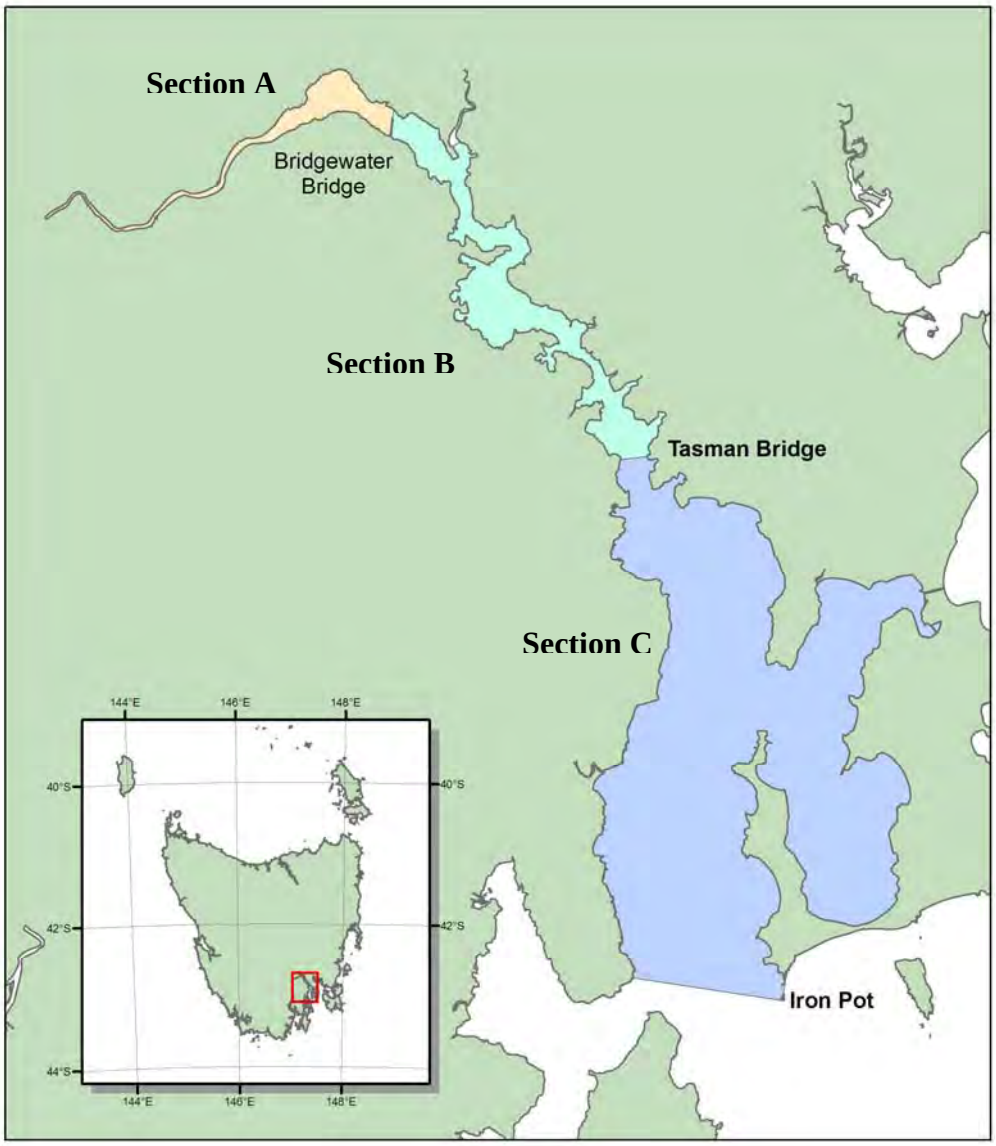


Figure 3. Reporting regions for the Derwent Estuary 2007 resurvey.

3.1 Bathymetry

Depth and GPS position were constantly recorded during the field surveys. From this data bathymetric contours were generated. While the fine scale contours are printed on the 1: 12,500 habitats maps an overview of the bathymetry of the estuary is presented in Figure 4.

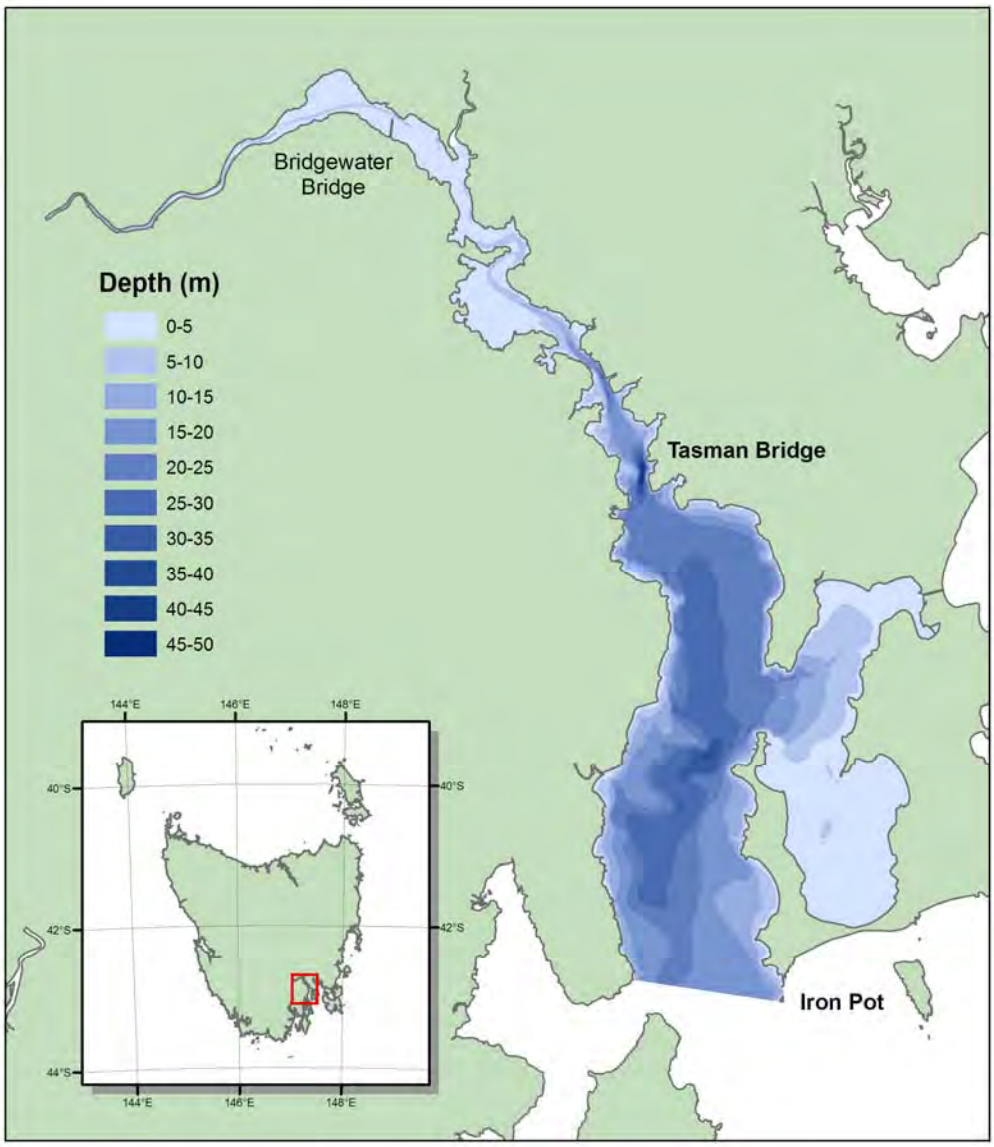


Figure 4. Bathymetry of the Derwent Estuary 2007.

3.2 Section A: Upper: Bridgewater Bridge to New Norfolk

The bathymetric record for Section A is shown in Figure 5. The habitat maps are presented in section 3.7 of this report. The bathymetric map shows that the region above the Bridgewater Bridge is mainly 5 m or less except for the main channel that is 10 m deep on average.

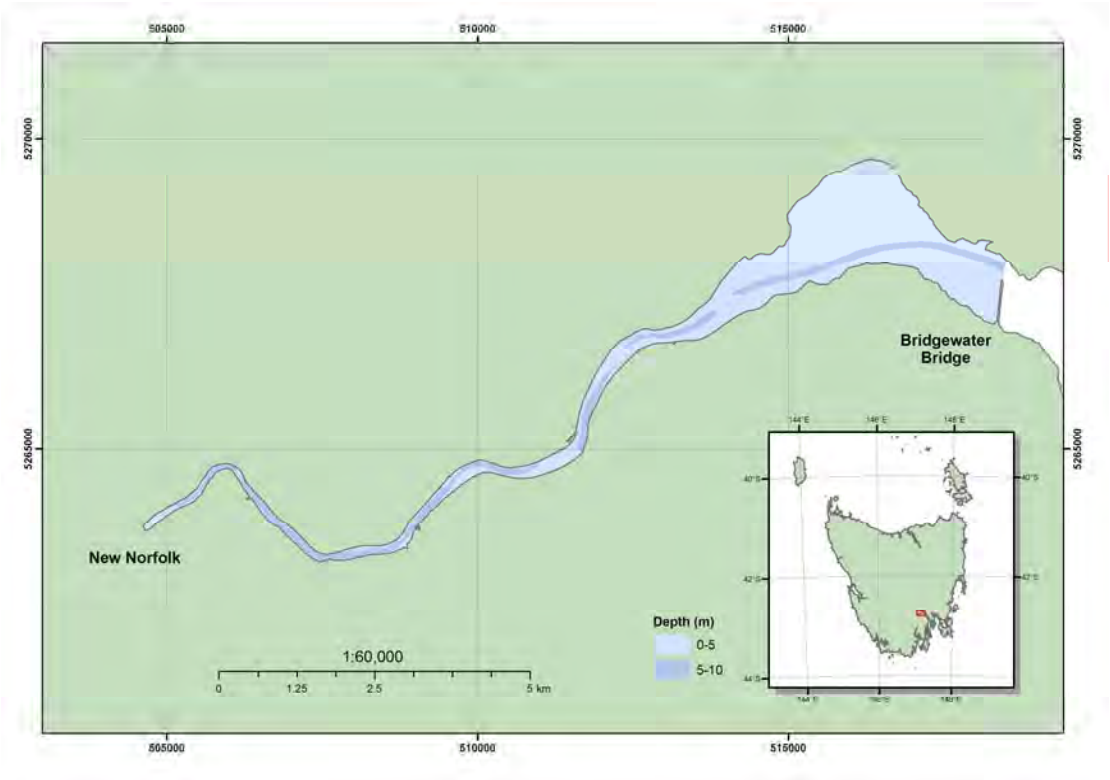


Figure 5. Section A Bathymetry from New Norfolk to Bridgewater Bridge

3.2.1 Habitat Distribution

The distributions of habitats (ha) by depth in Section A are shown in Table 2. At the top end of the estuary the majority of habitat consists of aquatic macrophytes and silt below low water mark and vegetated habitat from the low water mark to high water mark which could not be surveyed with by acoustic methods.

Depth range	Aquatic Macrophyte	Cobble	Reef	Sand	Seagrass	Silt	Vegetated
0-5	259.79	11.78	13.90			163.53	197.71
5-10		15.38	13.77			105.01	
10-15							
15+							
Total	259.79 ha	27.16 ha	27.67 ha	0	0	268.54ha	197.71 ha

Table 2. Distribution of marine habitats by depth in Section A.

3.2.2 Algal Distribution

There was very little consolidated substrate in the upper Derwent. The majority of the consolidated substrate occurred in the main river channel around New Norfolk, which was dominated by cobble and rocky ridges. There was little algal growth on the consolidated substrate partially due to the lack of light penetrating through the water column, and partially due to the high sediment load covering the consolidated substrate.

3.2.3 Seagrass Distribution

Extensive beds of the aquatic macrophyte *Ruppia megacarpa* and the seagrass *Heterozostera tasmanica* occurred on the shallow mud flats between the Bridgewater

Bridge and Dromedary. These beds were a mixture of both species, with *Ruppia* being the dominant component. The seagrass species, *Heterozostera* extended to approximately 2 m depth on the margins of the beds, with *Ruppia* common in less than 1 m depth.

3.3 Section B: Middle: Tasman Bridge to Bridgewater Bridge

The bathymetric record for Section B is shown in Figure 6. The bathymetric map shows that the upper region below the Bridgewater Bridge has a depth of < 5 m and starts to become deeper from Cornelian Bay to the southern end of the estuary.

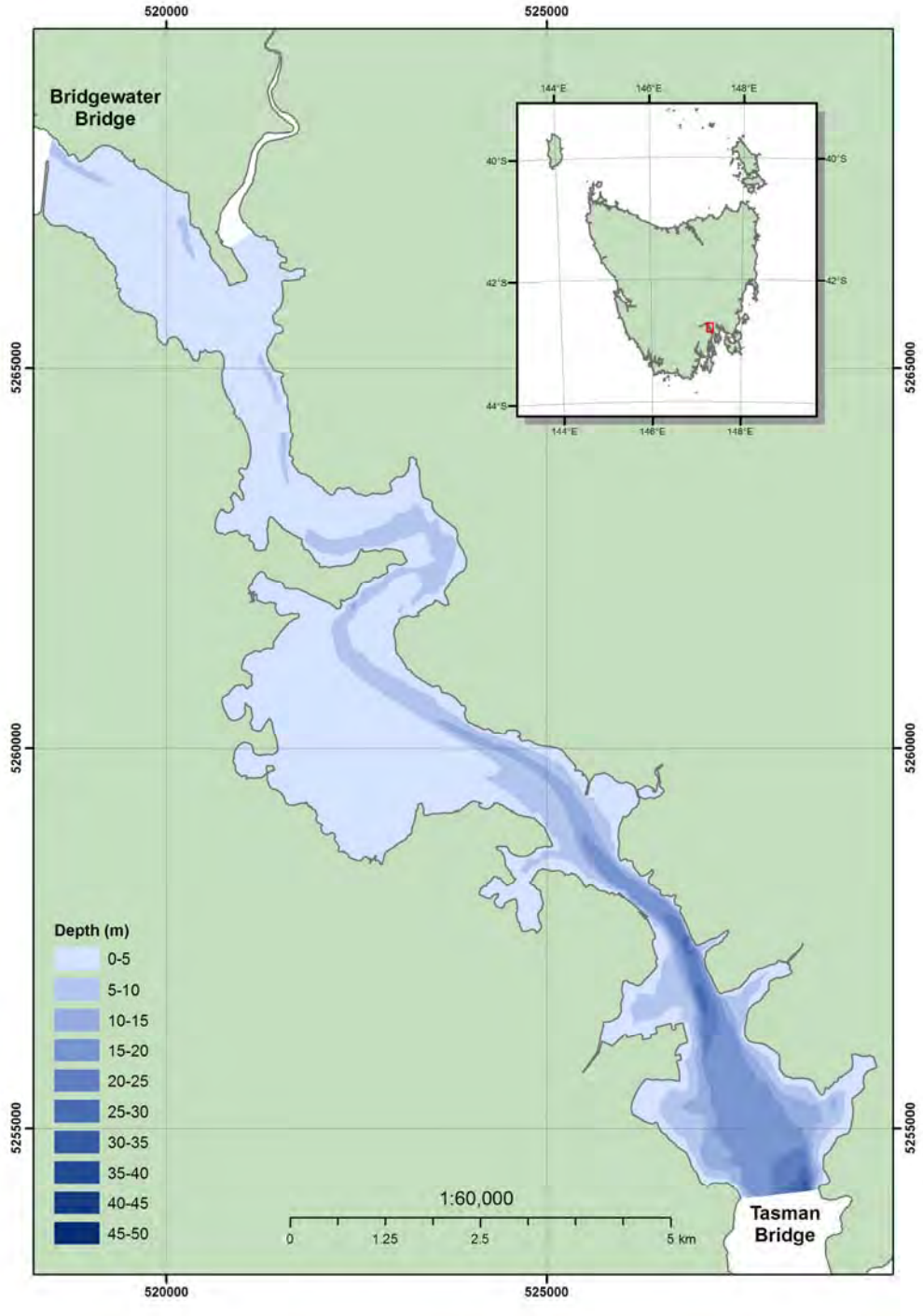


Figure 6. Section B Bathymetry from Bridgewater Bridge to Tasman Bridge

3.3.1 Habitat Distribution

The distributions of habitats (ha) by depth in Section B are shown in Table 3. A substantial amount of aquatic macrophytes (404 ha) was present to the southern side of the Bridgewater Bridge. The unconsolidated habitat was dominated by silt with only a small proportion of sand in this section of the estuary.

Depth	Aquatic Macrophyte	Cobble	Reef	Sand	Seagrass	Silt
0-5	404.05		46.98	1.7	9.27	1297.75
5-10	0.0029		0.18			411.04
10-15						138.44
15+						257.74
Total	404.05ha	0	47.16ha	1.7ha	9.27ha	2104.97ha

Table 3. Distribution of marine habitats by depth in Section B.

3.3.2 Algal Distribution

There was very little reef in the mid Derwent section, with the majority of the reef fringing the shoreline and extended to less than 2 m deep. The reef in the mid Derwent section was generally barren with little algal growth. The algae that was present was commonly filamentous red and brown algae.

3.3.3 Seagrass Distribution

In the middle reaches of the Derwent, between the Tasman Bridge and the Bridgewater Bridge there were numerous large beds (9.27 ha or 0.09km^2 in total) of *Heterozostera tasmanica*, often mixed with the aquatic macrophyte *Ruppia megacarpa*. The major beds were located south of the Bridgewater Bridge, in the mouth of the Jordan River, and opposite Austins Ferry. There was also a small bed of *Heterozostera tasmanica* in Cornelain Bay. This section of the river also has small amounts of the intertidal seagrass *Zostera mulleri* in some of the sheltered bays on the western shoreline, including Cornelian Bay and Prince of Wales Bay.

3.4 Section C: Lower: Tasman Bridge to Iron Pot

The bathymetric record for Section C is shown in Figure 7. The bathymetric map shows that below the Tasman Bridge a deep channel to 50 m is present. Ralphs Bay is characterised by depths of less than 5 m. Overall, the majority of area in the centre of the Derwent Estuary is characterised by depths between 20 and 30 metres.

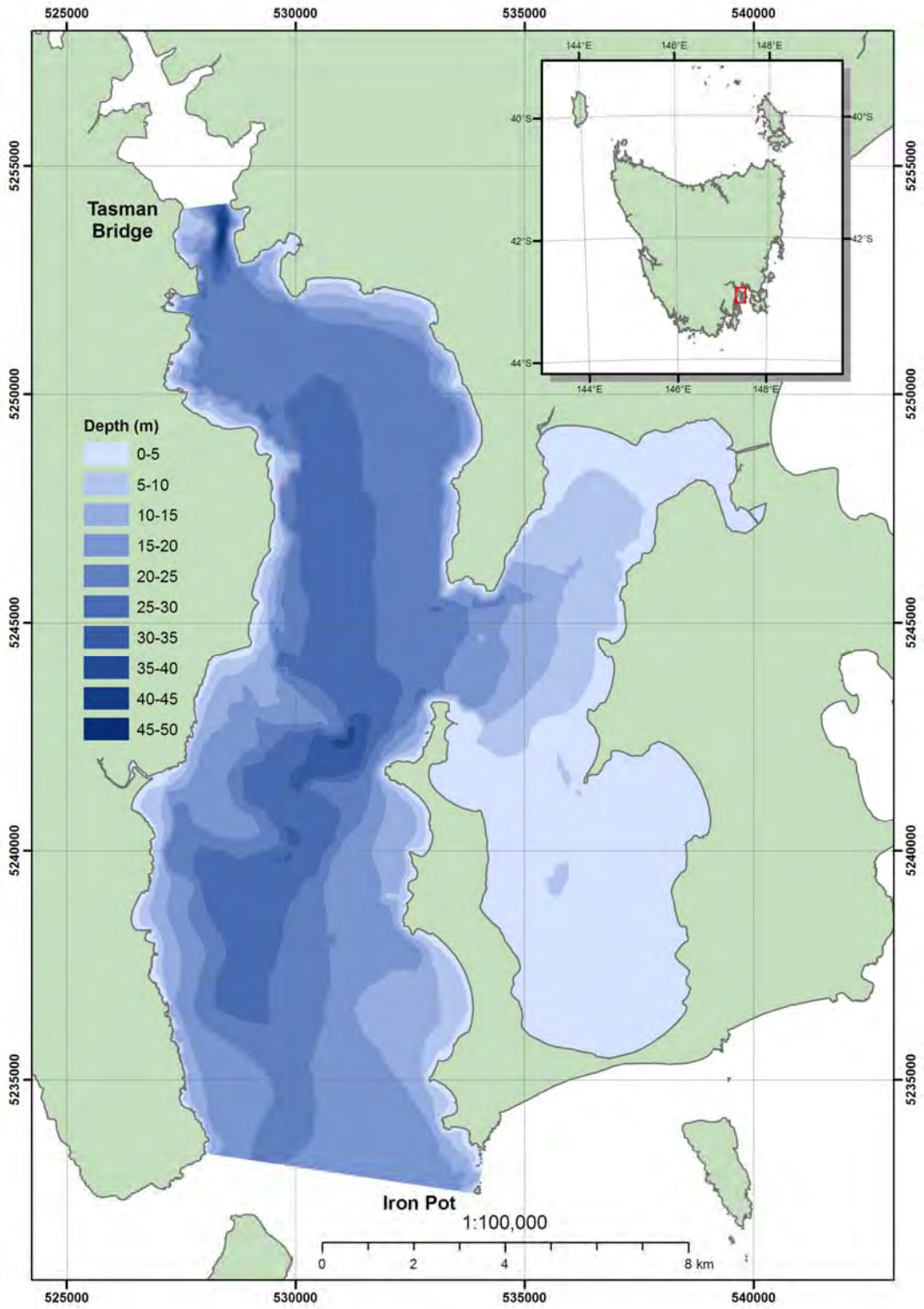


Figure 7. Section C Bathymetry from the Tasman Bridge to Iron Pot

3.4.1 Habitat Distribution

The distribution of habitats by depth is Section C is shown in table 4. The majority of reef habitat in this section was present in the 0-5 m depth range. Cobble and aquatic macrophytes were not mapped in this section. The deeper areas of this section consisted of silt habitat moving to sand up into the shallower regions.

Depth	Aquatic Macrophyte	Cobble	Reef	Sand	Seagrass	Silt
0-5			251.84	3977.12	8.712	38.84
5-10			62.75	1461.70	0.007	95.5
10-15			19.15	1300.22		300.74
15+			1.64	3699.44		4996.82
Total			335.38 ha	10,438.48 ha	8.719 ha	5431.9 ha

Table 4. Distribution of marine habitats by depth in Section C.

3.4.2 Algal Distribution

The majority of the macro algae occurred in this section of the Derwent. The waters of the lower Derwent have a stronger marine influence than further up the estuary, with the algal communities reflecting this influence. The algae on the eastern and western shorelines and Ralphs Bay showed differences in the algal composition, and so are described separately.

3.4.2.1 Western Shoreline

The section of coast from Tinderbox to Sandy Bay contains a significant proportion of the reef habitat within the Derwent Estuary. The distribution of algae along this section of coast reflects the more oceanic influence of Storm Bay. A mix of brown algae including *Ecklonia radiata*, *Lessonia corrugata*, *Cystophora confluens, Acrocarpia paniculata* and *Carpoglossum confluens* dominated the shallow water. Smaller amounts of *Sargassum* sp., *Caulocystis* sp., mixed red algae, *Ulva* and *Caulerpa* sp. were also present along this section of coast. Beyond 5 metres, where light was limited, red algae became the more dominant component, although this became sparse and patchy below 7 metres depth. The introduced kelp, *Undaria pinitifida* was also present in small quantities below 5 metres depth. On the fringes of the deeper sections of reef occasional sponges were noted. *Macrocystis pyrifera* was present on the shoreline from Tinderbox to Taroona, especially just south of Blackmans Bay.

3.4.2.2 Eastern Shoreline

The eastern shoreline of the Derwent River has less of an oceanic influence than the western shoreline. This is reflected in the algal community structure. Around South Arm, at the entrance to the river a suite of algae including *Ecklonia Ulva, Acrocarpia, Cystophora* and *Sargassum* occur in the shallow water, with *Carpoglossum* and mixed red algae generally in the deeper water. Further up the river past Opossum Bay *Ecklonia radiata, Cystophora sp.* and mixed reds dominated in shallow water to around 3 metres depth. Below this depth, the algae generally dropped out, with the reef remaining relatively barren. The further north the samples were taken, the less the large macro algaes were noted.

3.4.2.3 Ralphs Bay

There was little reef mapped within Ralph's Bay, however at the entrance to the bay a significant area was identified. A mix of *Codium sp.*, filamentous brown algae and mixed red algae dominated the habitats in less than 3 metres. Invertebrate communities generally dominated deeper reef in this area, with the reef in this area being covered in fine sediments.

3.4.3 Seagrass Distribution

In the lower reaches, below the Tasman Bridge, *Heterozostera tasmanica* was the dominant seagrass species. Beds were observed between the 1 m and 5 metre depth range in Halfmoon Bay, Opossum Bay, and off Taroona. These beds generally had short to medium blade length, with sparse to dense growth. In 2000, a large bed of seagrass was mapped in the northern part of Opossum Bay. This bed was lost in early 2001 during a large storm event, which washed most of the sand away and exposed the underlying reef.

3.5 Introduced Species

Several introduced species were observed on the video including the seastar *Asterias amurensis*, the New Zealand screwshell *Maoriculpus roseus*, the fan worm *Myxicola infundibulum*, the Pacific oyster, *Crassostrea gigas*, and the kelp *Undaria pinnatifida*. A total of 63 video transects were used to identify the broad patterns of these species distribution in the river (Appendix 1 and 2). However, as this was not a comprehensive video survey for introduced species, these ranges are indicative only. The seastar, *Asterias amurensis*, showed a broad distribution through the lower and middle Derwent, including Ralphs Bay. This species was predominantly observed on soft sediment habitat, but also occurred on reef. In the middle reaches, between Sullivans Cove and Dogshear Point, the seastar *Patiriella regularis* was observed on silt habitat in many of the video transects. This seastar is believed to have been introuduced from New Zealand with the introduction of oysters in the early 1900s (Edgar 1997).

The New Zealand screw shell, *Maoriculpus roseus*, was only observed in the lower Derwent, especially around Opossum Bay, Taroona, and the entrance to Ralphs Bay. The majority of the shells were observed on soft sediment habitat, with a small amount occurring within gutters in reef. Live screw shells were observed in the mid Derwent between Opossum Bay and Taroona, however the majority of screw shells observed were dead shell.

The fan worm, *Myxicola infundibulum*, was observed on silt substrate in the mid Derwent between Elwick bay and Sandy Bay, and also in Ralphs Bay. Burrows were also observed between Bridgewater and Opossum Bay. As this species has the ability to quickly retract its feeding tentacles, these burrows may have belonged to this species, but it is impossible to determine using towed video.

Oysters were observed on the video in the mid Derwent, especially between Cornelian Bay and Austins Ferry. This species predominantly occurs in the intertidal zone, which was unable to be surveyed using the vessel towed video. Thus, this distribution reflects the subtidal distribution of this species and not those found on intertidal rock platforms.

The introduced kelp *Undaria pinnatifida* was found to occur on the deeper margins of reef along the western shoreline of the lower Derwent, from Tinderbox to Taroona. This species was first noted in the Tinderbox marine reserve in the late 1990 and this distribution represents the population spreading from this site.

3.6 Summary of habitats across the Derwent Estuary

Tables 5 to 8 summaries the distribution of marine habitats of the Derwent Estuary by section; by depth; and across the entire estuary as a per centage cover of all habitats identified.

Table 5 summarised the marine habitats by section. The majority of the area in Section A is characterised by aquatic macrophytes, silt and vegetated habitat in the zone between the high and low water mark. Small amounts of reef and cobble were also present. In section B larger amounts of reef were identified with silt and aquatic macrophytes still being the dominant habitats. In section C aquatic macrophytes or cobble were not mapped. This section contained the largest proportion of reef and sand habitat with silt habitat dominating the deeper waters in the centre of the estuary.

Habitat	Section A	Section B	Section C	Total (ha)
Aquatic Macrophytes	259.8	404.05	0	663.85
Cobble	27.16	0	0	27.16
Reef	27.68	47.16	335.38	410.20
Sand	0	1.70	10438.48	10440.18
Seagrass	0	9.24	8.72	17.96
Silt	268.55	2104.97	5431.91	7805.42
Vegetated	197.71			197.71

Table 5. Summary of marine habitats by Section.

Table 6 presents the distribution of all habitat types across the entire estuary by depth. Aquatic macrophytes occurred predominantly in the 0-5 metre depth range of the estuary. Cobble was identified in depths between 0 and 10 metres. Fringing reef dominated in the 0-5 m depth range but was present in all depth strata of the estuary. Seagrass was mainly present in the 0-5 depth strata with a small amount identified in the 5- 10 metre depth range. Sand was the dominant unconsolidated habitat type in the Section C of the estuary but was replaced by silt in the deeper margins.

Depth	Aquatic Macrophytes	Cobble	Reef	Sand	Seagrass	Silt	Vegetated
0-5	663.85	11.78	312.72	3978.82	17.95	1500.13	197.71
5-10	0.0029	15.38	76.7	1461.70	0.007	611.55	
10-15			19.15	1300.22		439.18	
15+			1.64	3699.44		5254.56	
Total	663.85ha	27.16ha	410.20ha	10440.18ha	17.96ha	7805.42ha	197.71ha

Table 6. Distribution of marine habitats by depth across the entire estuary

Table 7 and 8 show the percentage cover of each habitat type by section and across the whole estuary. The estuary is dominated by unconsolidated habitats with sand representing 53.37% and silt 39.9% of all habitats surveyed. Aquatic macrophytes were the next dominant habitat at 3.39% followed by reef, 2.1%.

Section	Aquatic Macrophytes	Cobble	Reef	Sand	Seagrass	Silt	Vegetated	Total
A	33.3 %	3.48%	3.54%	0%	0%	34.4%	25.32%	100%
B	15.74%	0%	1.84%	0.066%	0.36%	82%	0%	100%
C	0%	0%	2.06%	64.38%	0.054%	33.5%	0%	100%

Table 7. Percentage of habitat cover across each section of the estuary

Aquatic Macrophytes	Cobble	Reef	Sand	Seagrass	Silt	Vegetated	Total
3.39%	0.14%	2.1%	53.37%	0.09%	39.9%	1.01%	100%

Table 8. Percentage of habitat cover across the whole estuary

3.7 Benthic habitat maps of the Derwent Estuary

The habitat maps of the Derwent Estuary, as determined by the map index in Figure 8, are presented in this section.

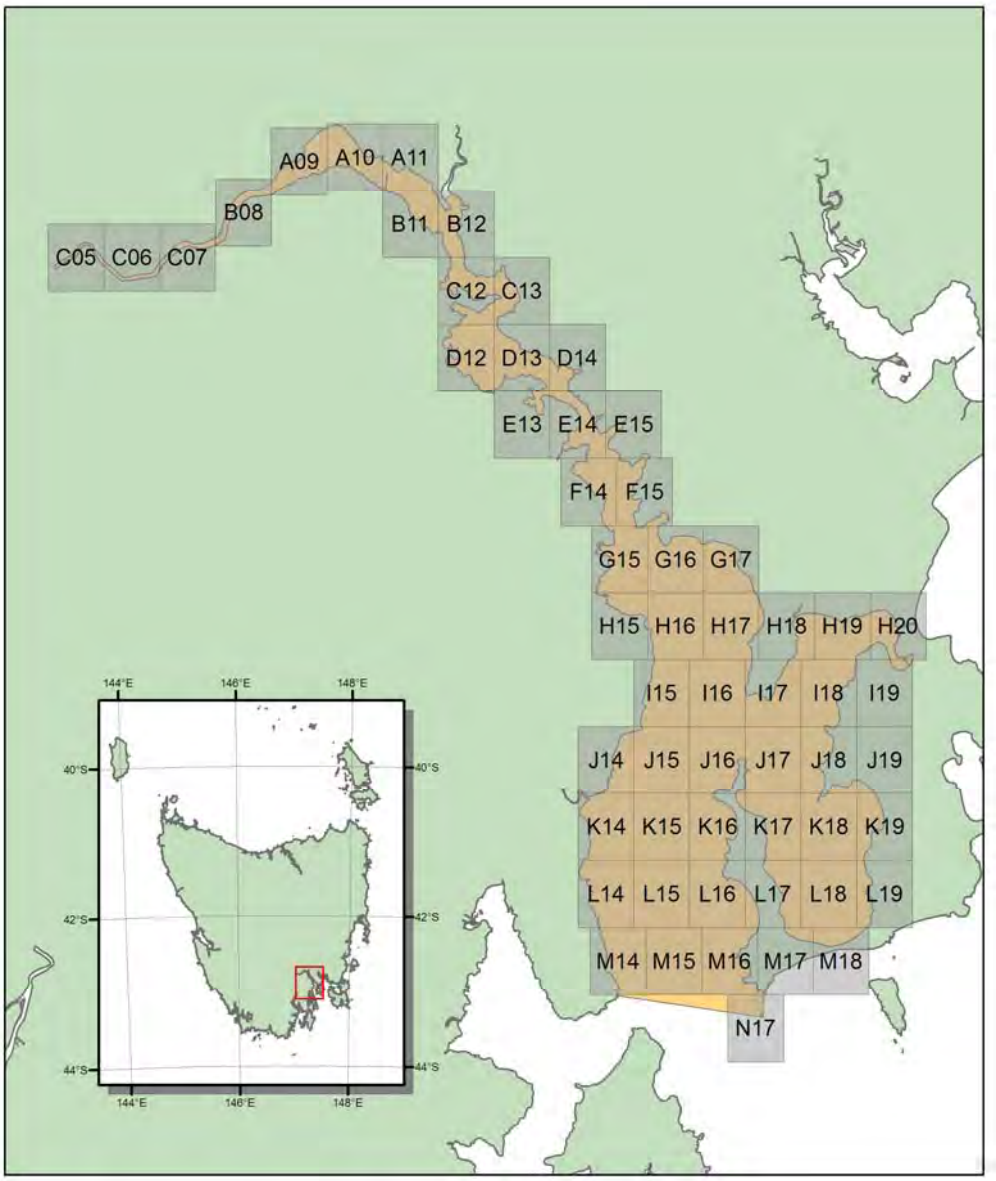
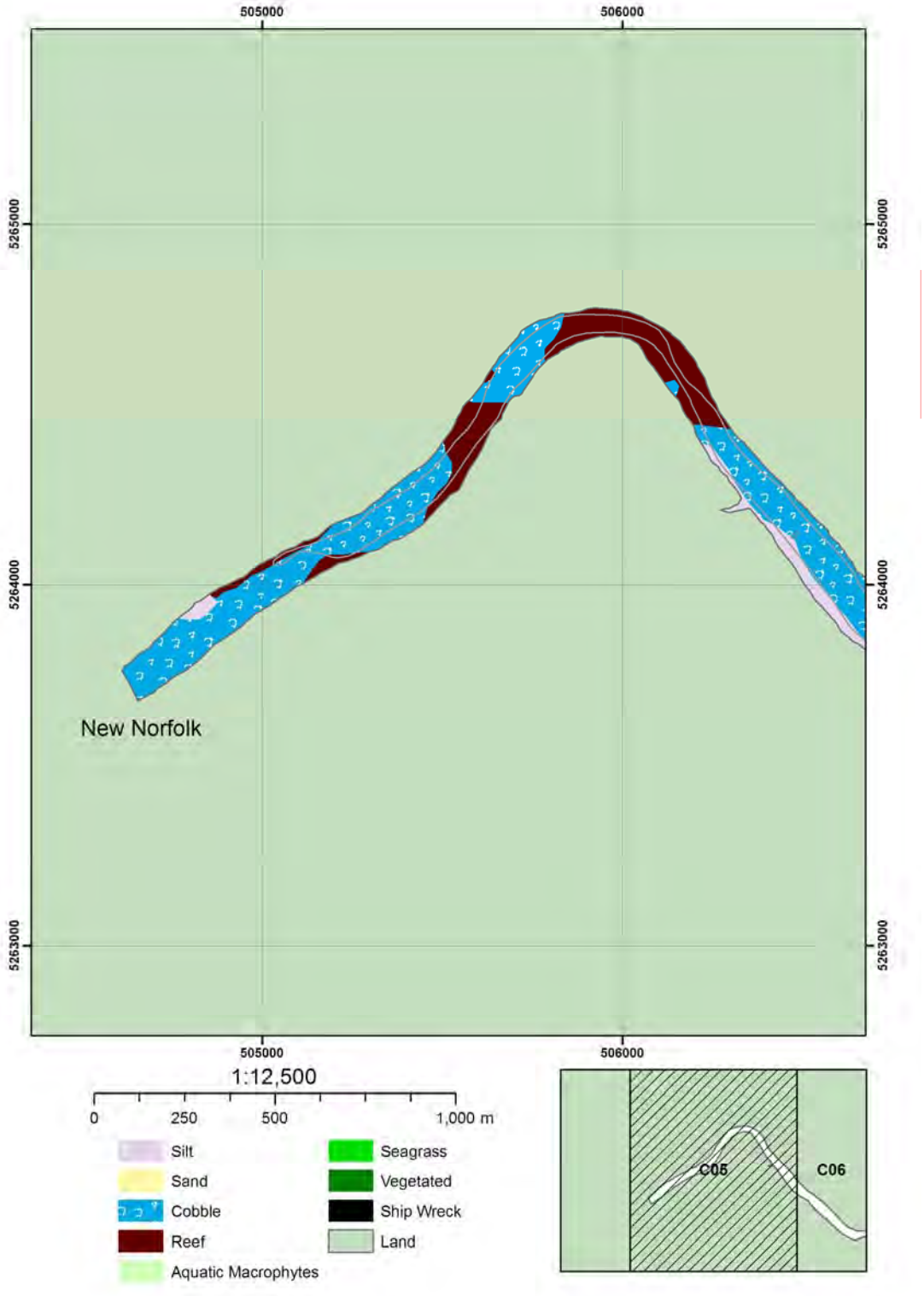


Figure 8. Map Index for marine habitat maps from New Norfolk to Iron Pot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506000
5265000
5264000
5263000
New Norfolk
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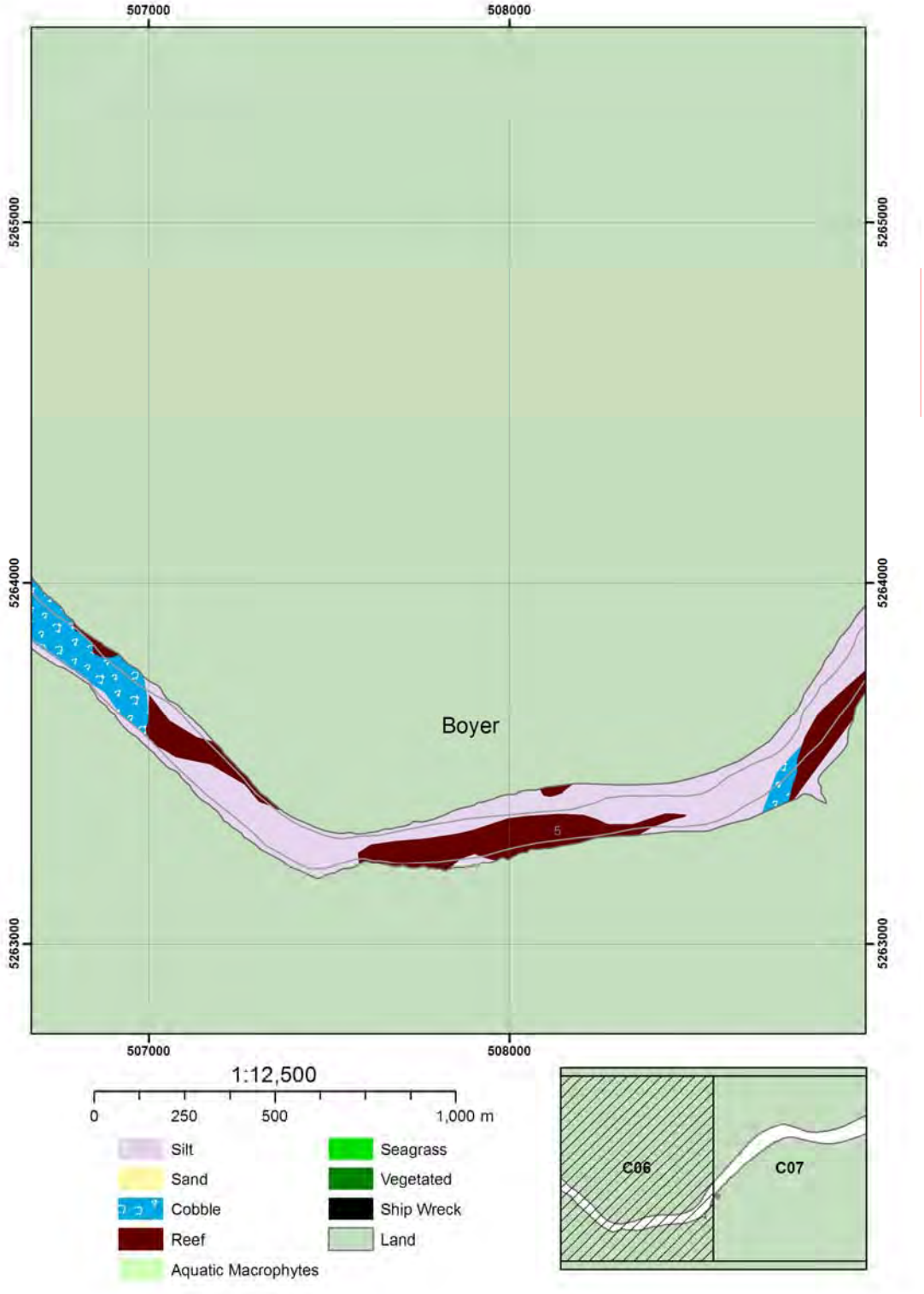
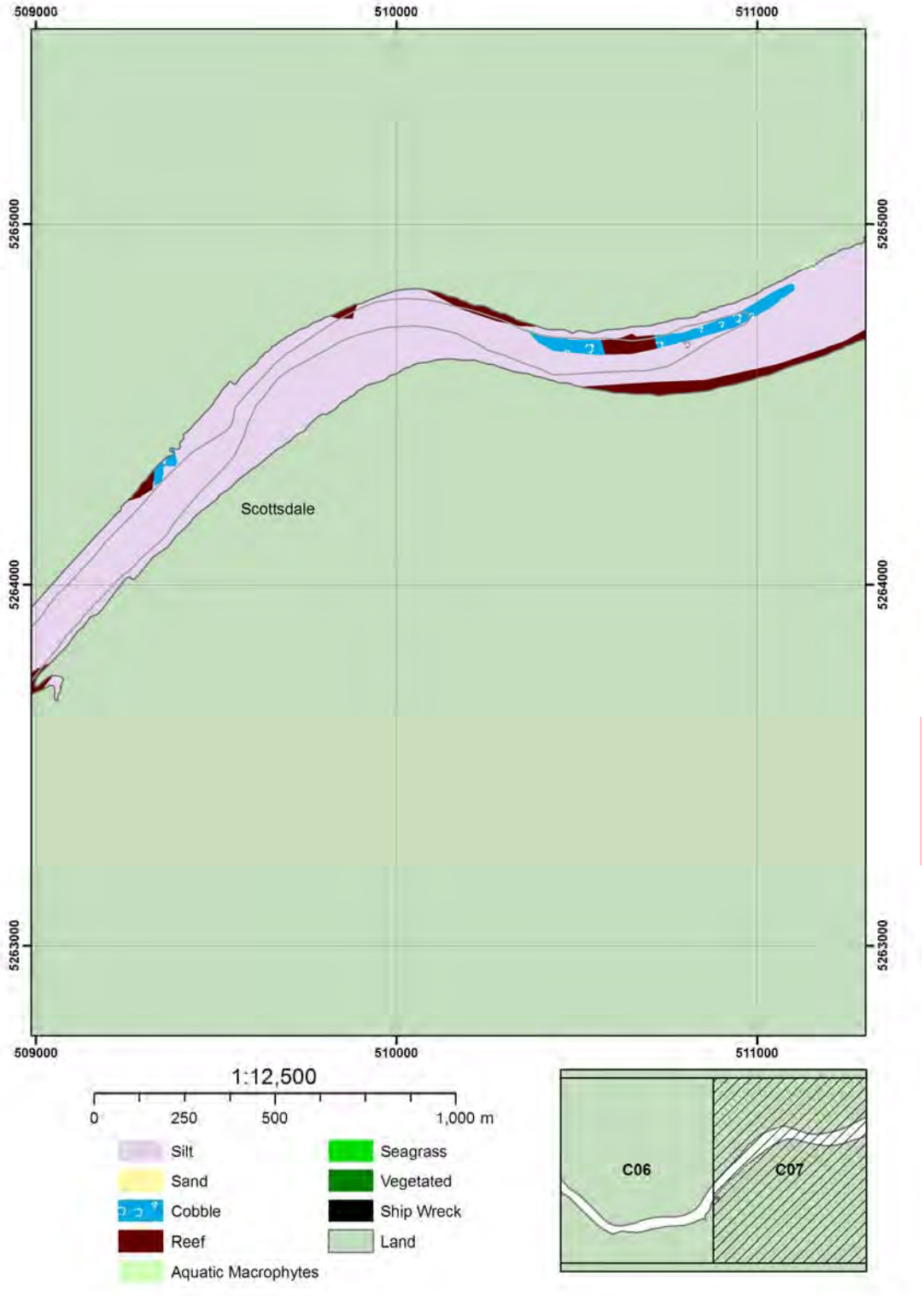
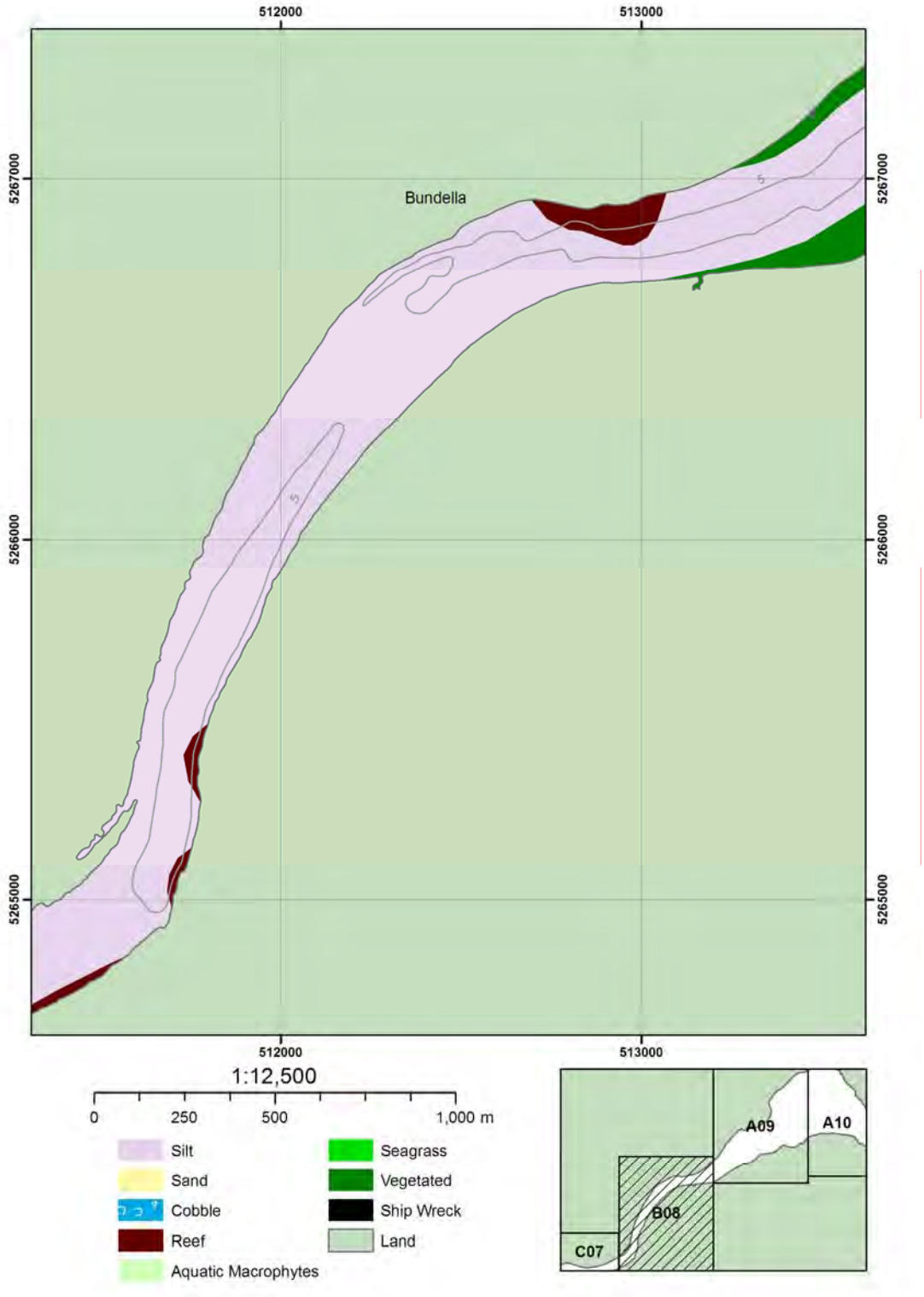
0
250
500
1,000 m
Silt
Sand
Cobble
Reef
Aquatic Macrophytes
Seagrass
Vegetated
Ship Wreck
Land
C05
C06


507000
508000
5265000
5264000
5263000
Boyer
1:12,500
0
250
500
1,000 m
Silt
Sand
Cobble
Reef
Aquatic Macrophytes
Seagrass
Vegetated
Ship Wreck
Land
C06
C07


509000
510000
511000
5265000
5264000
5263000
Scottsdale
1:12,500
0
250
500
1,000 m
Silt
Sand
Cobble
Reef
Aquatic Macrophytes
Seagrass
Vegetated
Ship Wreck
Land
C06
C07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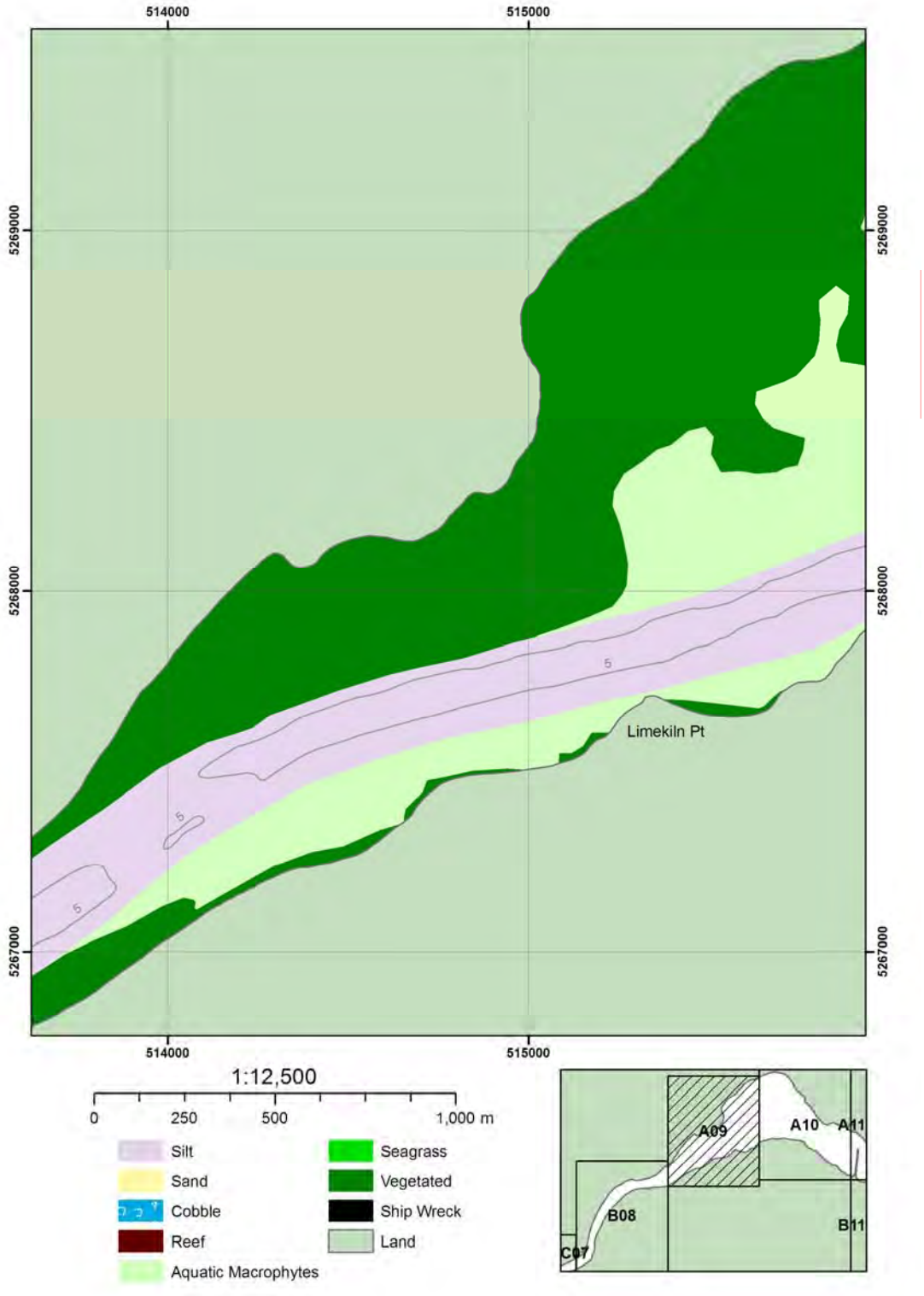
513000
5267000
5266000
5265000
Bundella
1:12,500
0
250
500
1,000 m
Silt
Sand
Cobble
Reef
Aquatic Macrophytes
Seagrass
Vegetated
Ship Wreck
Land
A09
A10
B08
C07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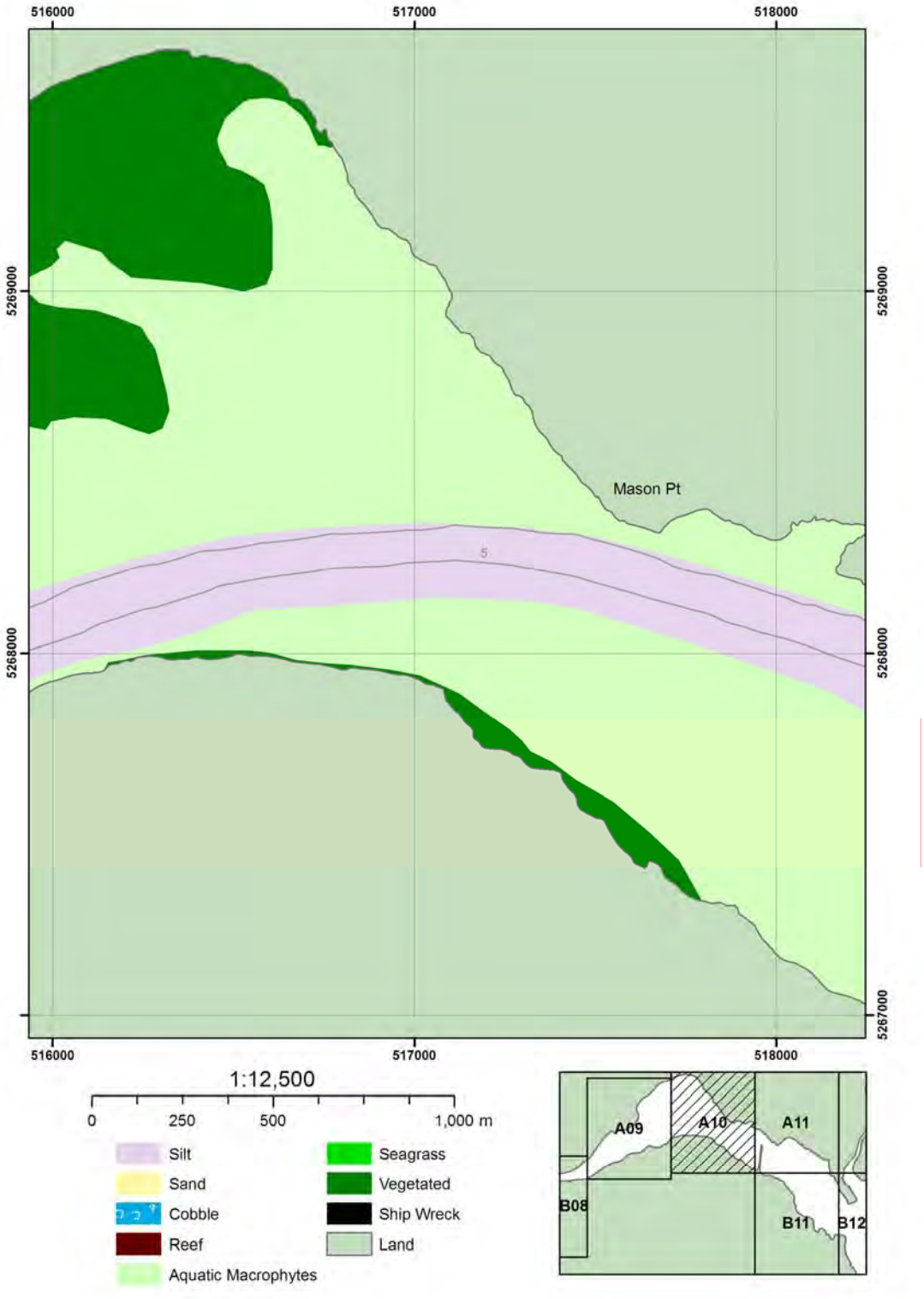
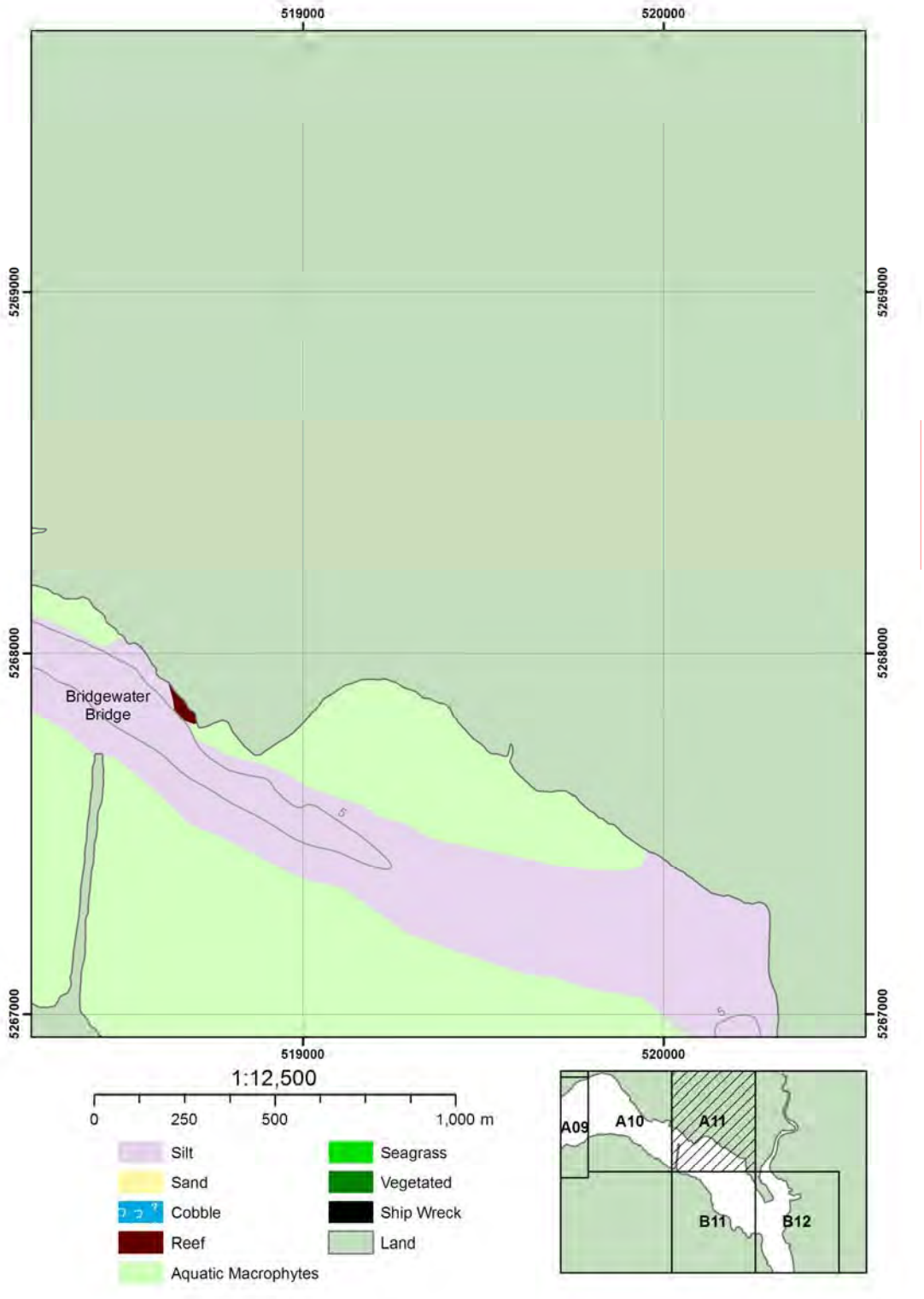
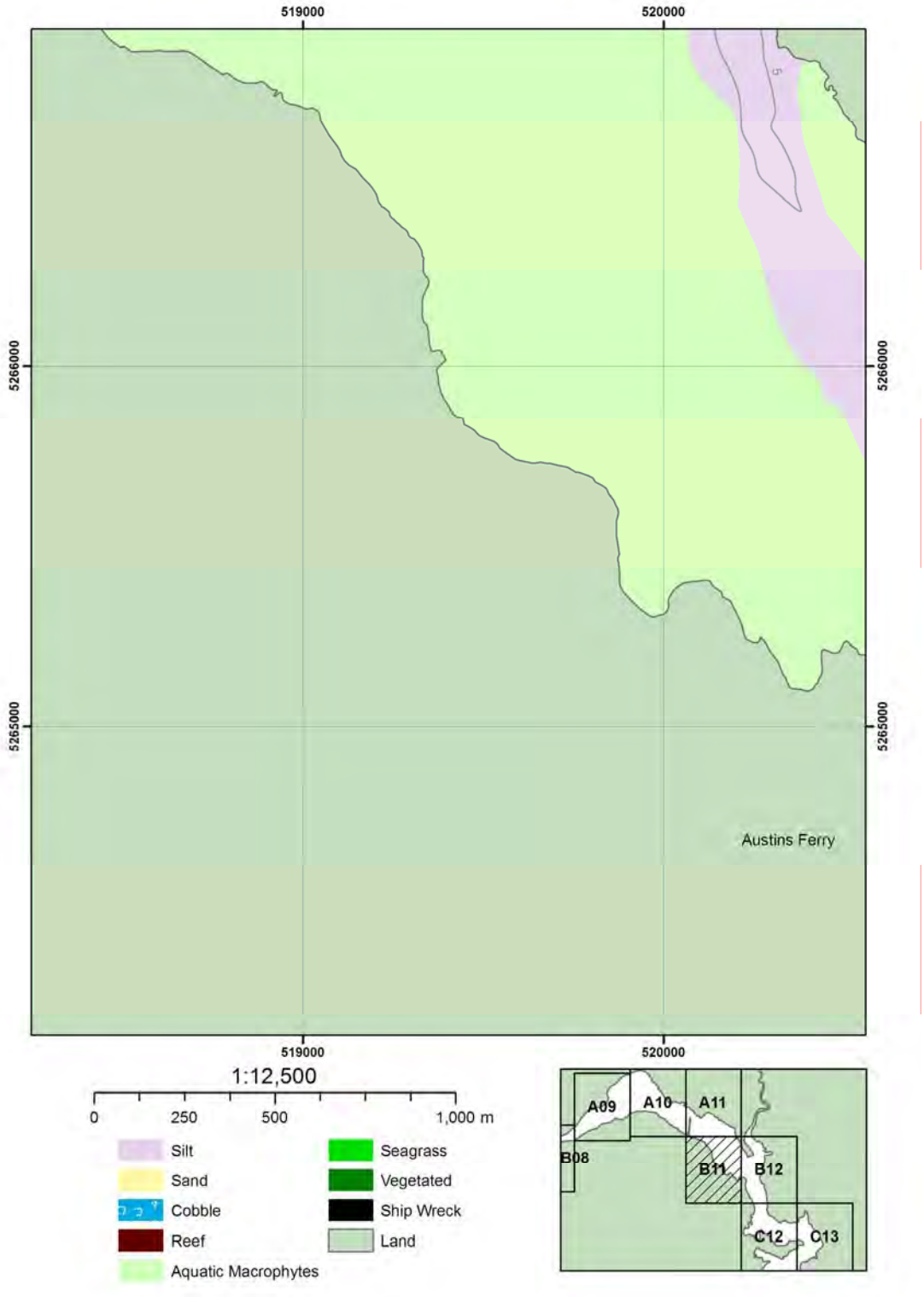
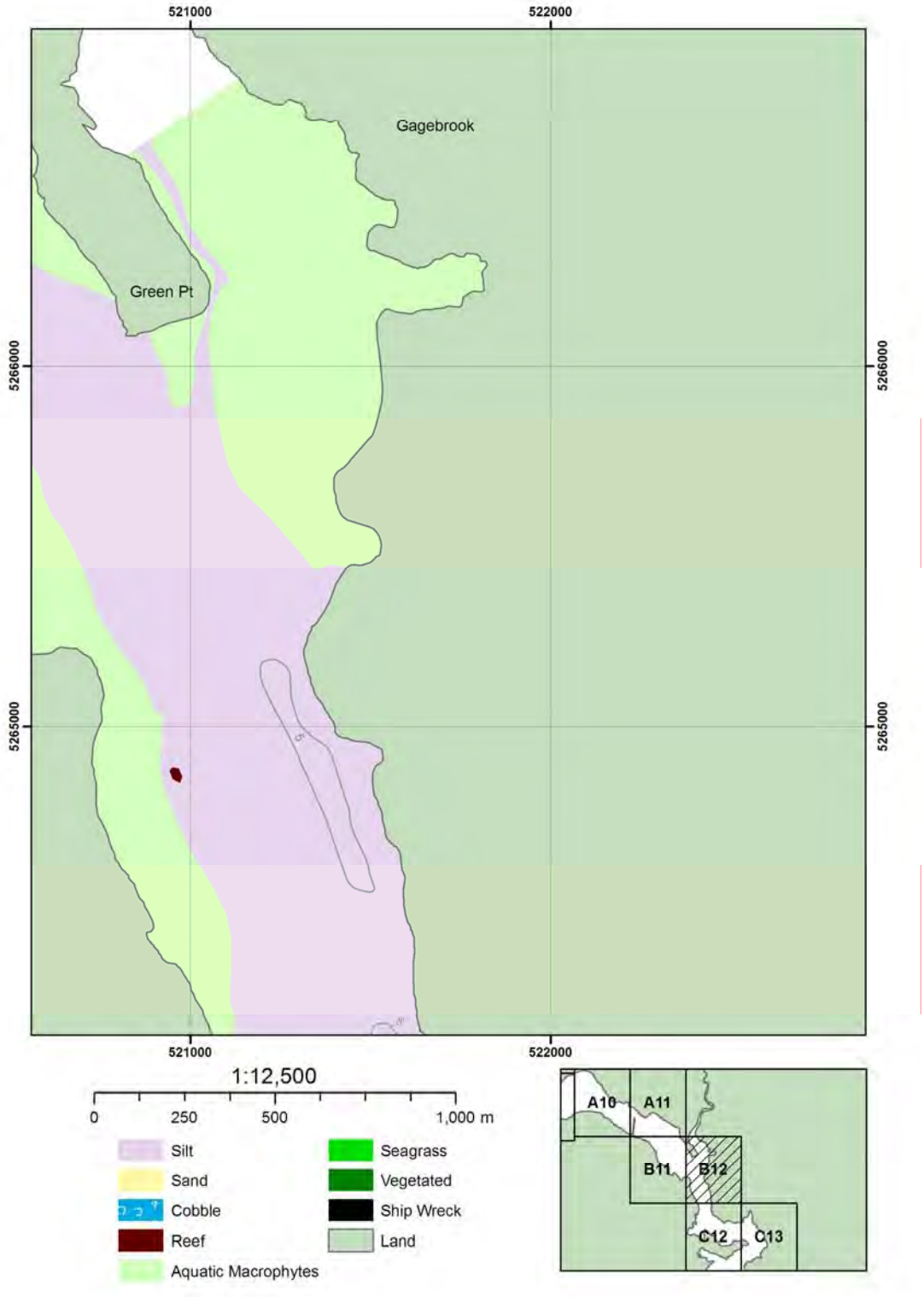
515000
5269000
5268000
5267000
Limekiln Pt
5
1:12,500
0
250
500
1,000 m
Silt
Sand
Cobble
Reef
Aquatic Macrophytes
Seagrass
Vegetated
Ship Wreck
Land
A09
A10
A11
B08
B11
C07


516000
517000
518000
5269000
5268000
5267000
Mason Pt
5
1:12,500
0
250
500
1,000 m
Silt
Sand
Cobble
Reef
Aquatic Macrophytes
Seagrass
Vegetated
Ship Wreck
Land
A09
A10
A11
B08
B11
B12


519000
520000
5269000
5268000
5267000
Bridgewater
Bridge
1:12,500
0
250
500
1,000 m
Silt
Sand
Cobble
Reef
Aquatic Macrophytes
Seagrass
Vegetated
Ship Wreck
Land
A09
A10
A11
B11
B12


519000
520000
5266000
5265000
Austins Ferry
1:12,500
0
250
500
1,000 m
Silt
Sand
Cobble
Reef
Aquatic Macrophytes
Seagrass
Vegetated
Ship Wreck
Land
A09
A10
A11
B08
B11
B12
C12
C13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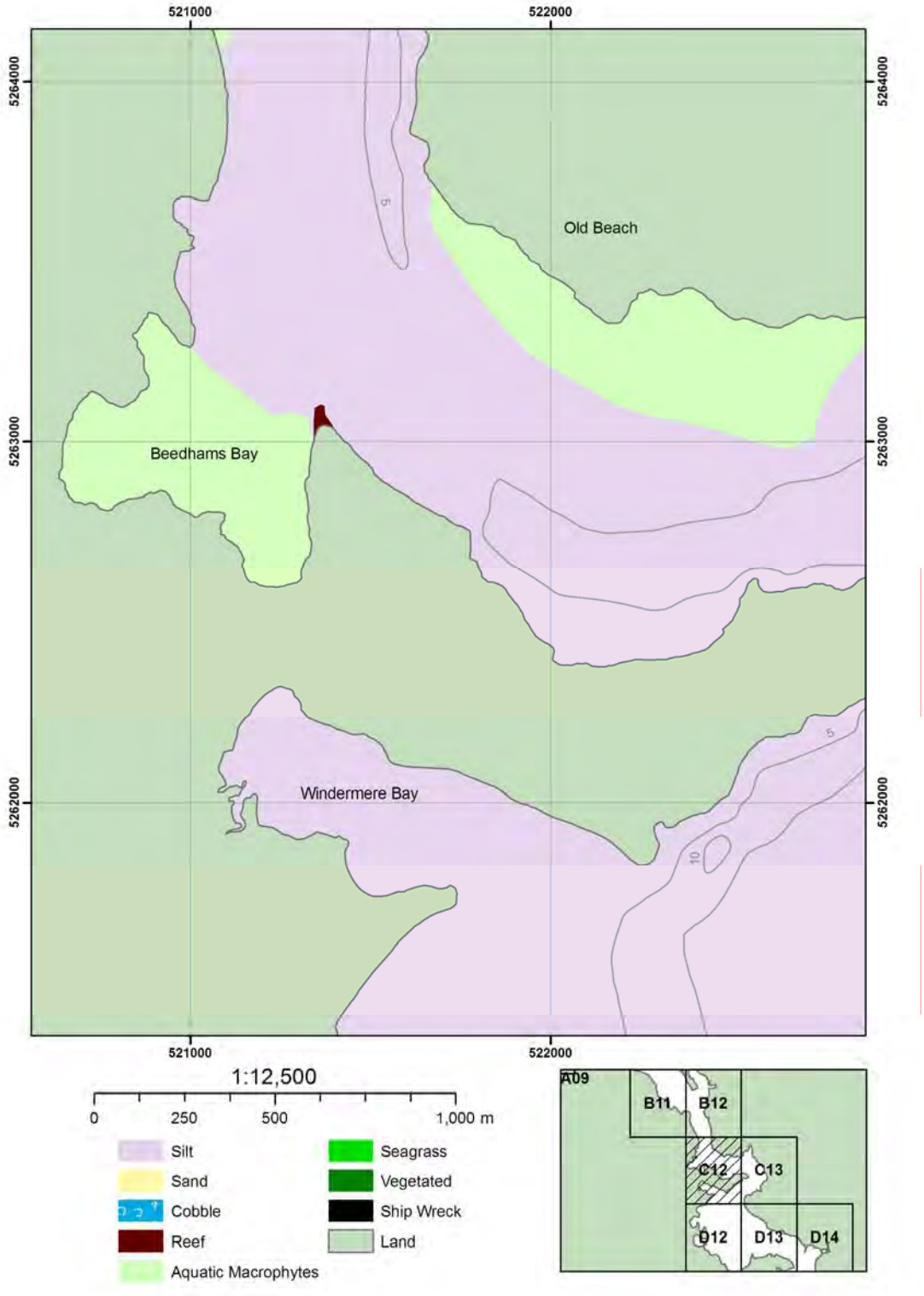
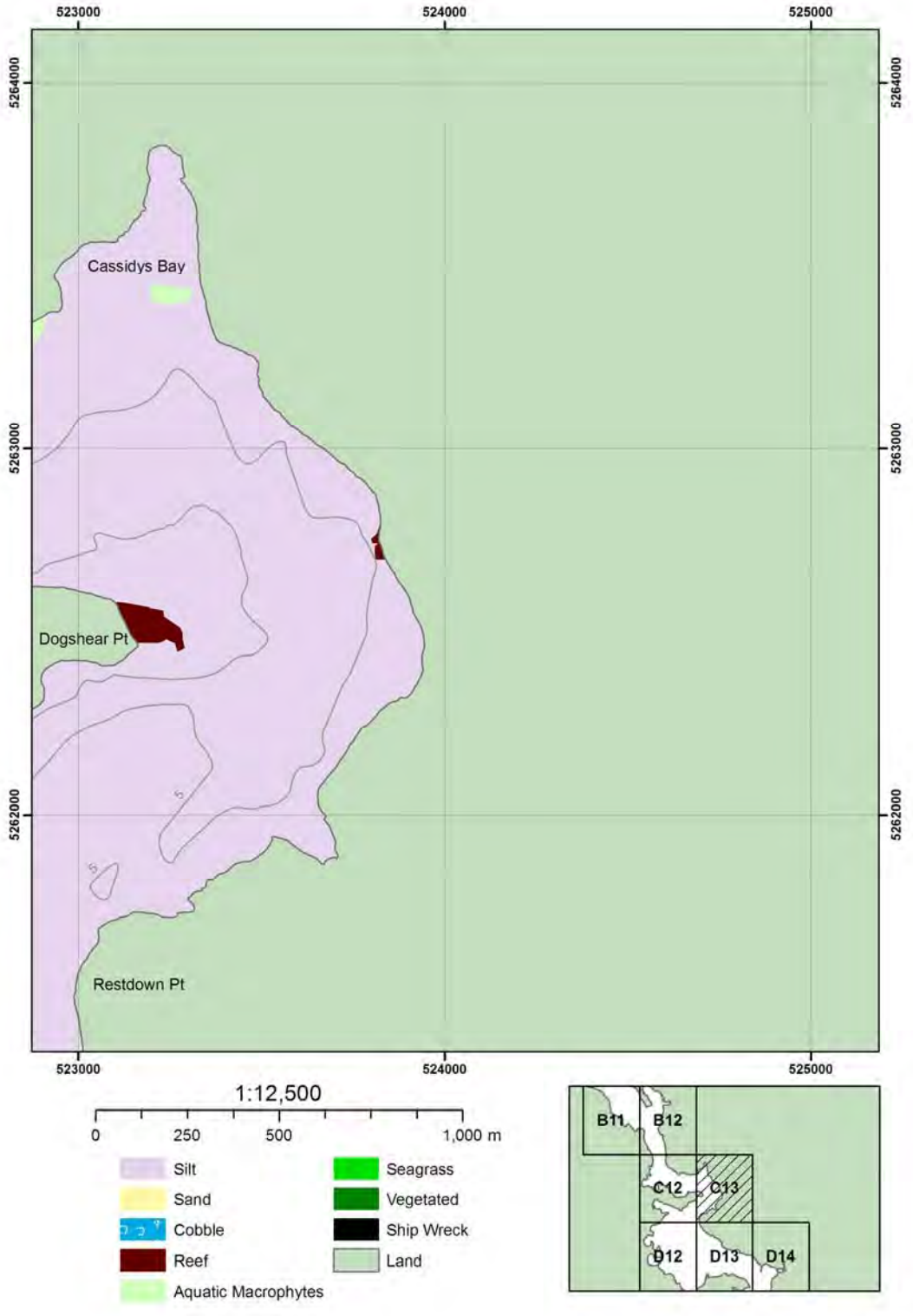
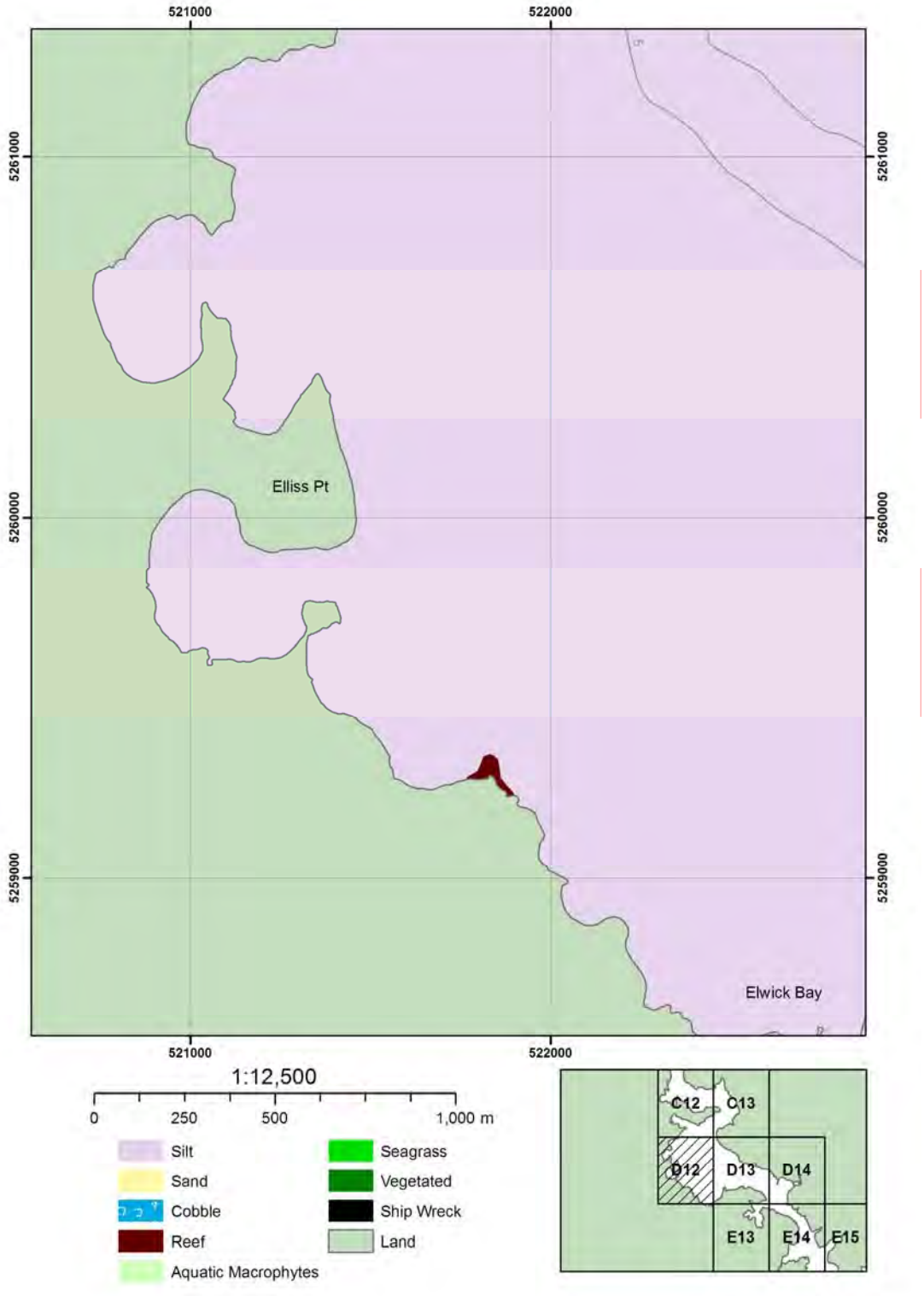
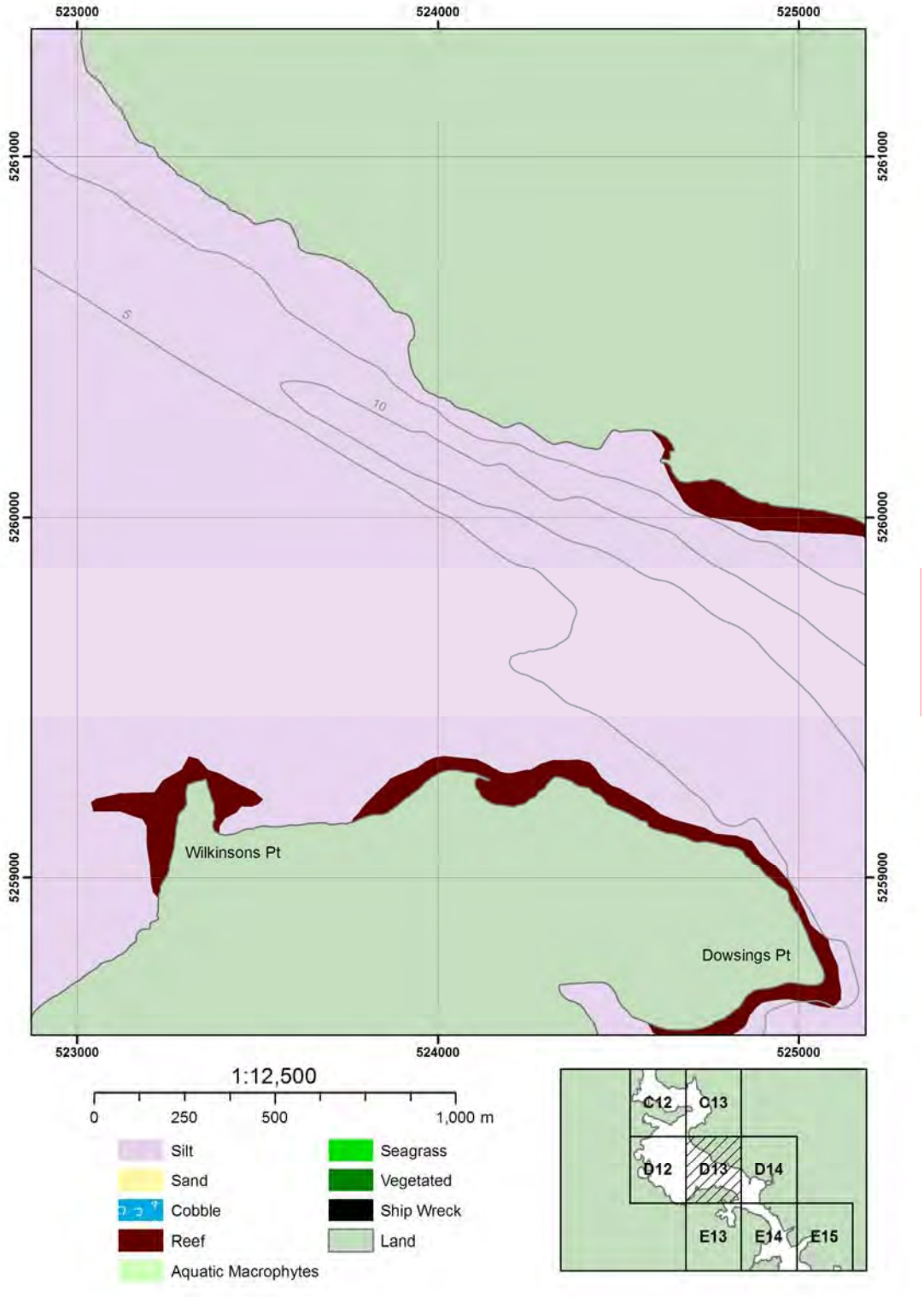
522000
Gagebrook
Green Pt
5266000
5265000
1:12,500
0
250
500
1,000 m
Silt
Sand
Cobble
Reef
Aquatic Macrophytes
Seagrass
Vegetated
Ship Wreck
Land
A10
A11
B11
B12
C12
C13


521000
522000
5264000
5263000
5262000
Old Beach
Beedhams Bay
Windermere Bay
5
10
1:12,500
0
250
500
1,000 m
Silt
Sand
Cobble
Reef
Aquatic Macrophytes
Seagrass
Vegetated
Ship Wreck
Land
A09
B11
B12
C12
C13
D12
D13
D14


523000
524000
525000
5264000
5263000
5262000
Cassidys Bay
Dogshear Pt
Restdown Pt
1:12,500
0
250
500
1,000 m
Silt
Sand
Cobble
Reef
Aquatic Macrophytes
Seagrass
Vegetated
Ship Wreck
Land
B11
B12
C12
C13
D12
D13
D14


521000
522000
5261000
5260000
5259000
Elliss Pt
Elwick Bay
1:12,500
0
250
500
1,000 m
Silt
Sand
Cobble
Reef
Aquatic Macrophytes
Seagrass
Vegetated
Ship Wreck
Land
C12
C13
D12
D13
D14
E13
E14
E15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525000
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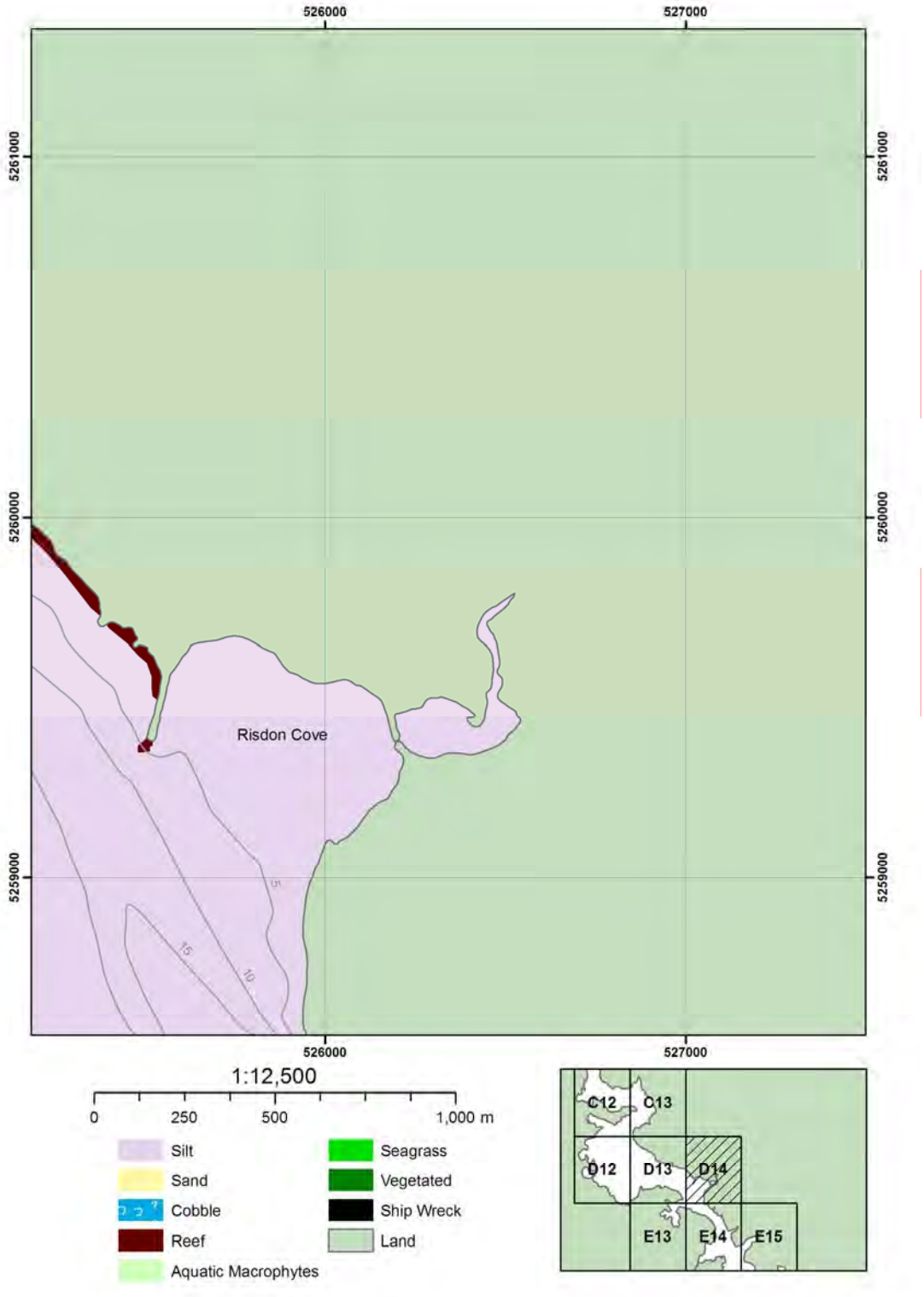
5259000
5
10
Wilkinsons Pt
Dowsings Pt
1:12,500
0
250
500
1,000 m
Silt
Sand
Cobble
Reef
Aquatic Macrophytes
Seagrass
Vegetated
Ship Wreck
Land
C12
C13
D12
D13
D14
E13
E14
E15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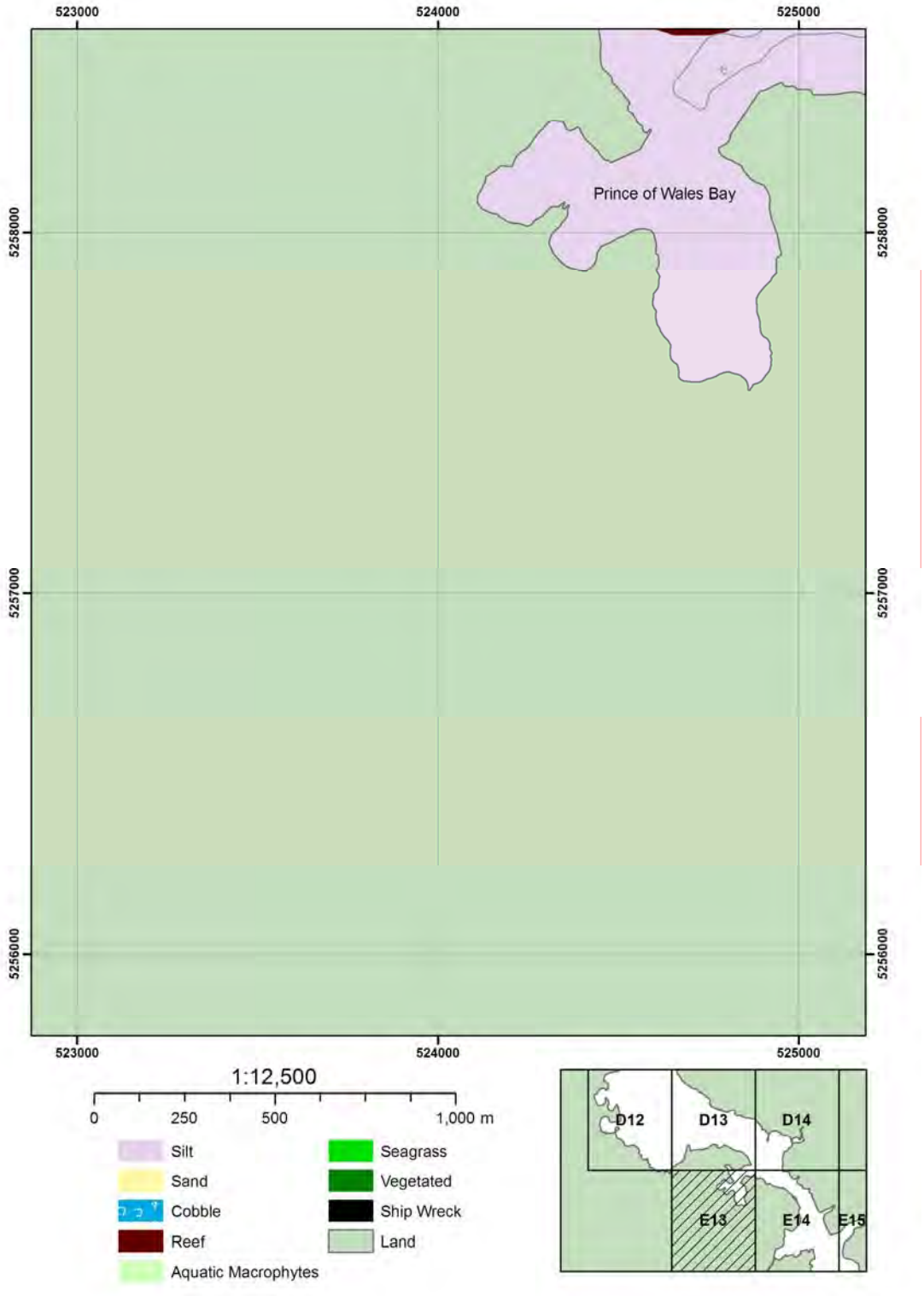
527000
5261000
5260000
5259000
Risdon Cove
5
10
15
1:12,500
0
250
500
1,000 m
Silt
Sand
Cobble
Reef
Aquatic Macrophytes
Seagrass
Vegetated
Ship Wreck
Land
C12
C13
D12
D13
D14
E13
E14
E15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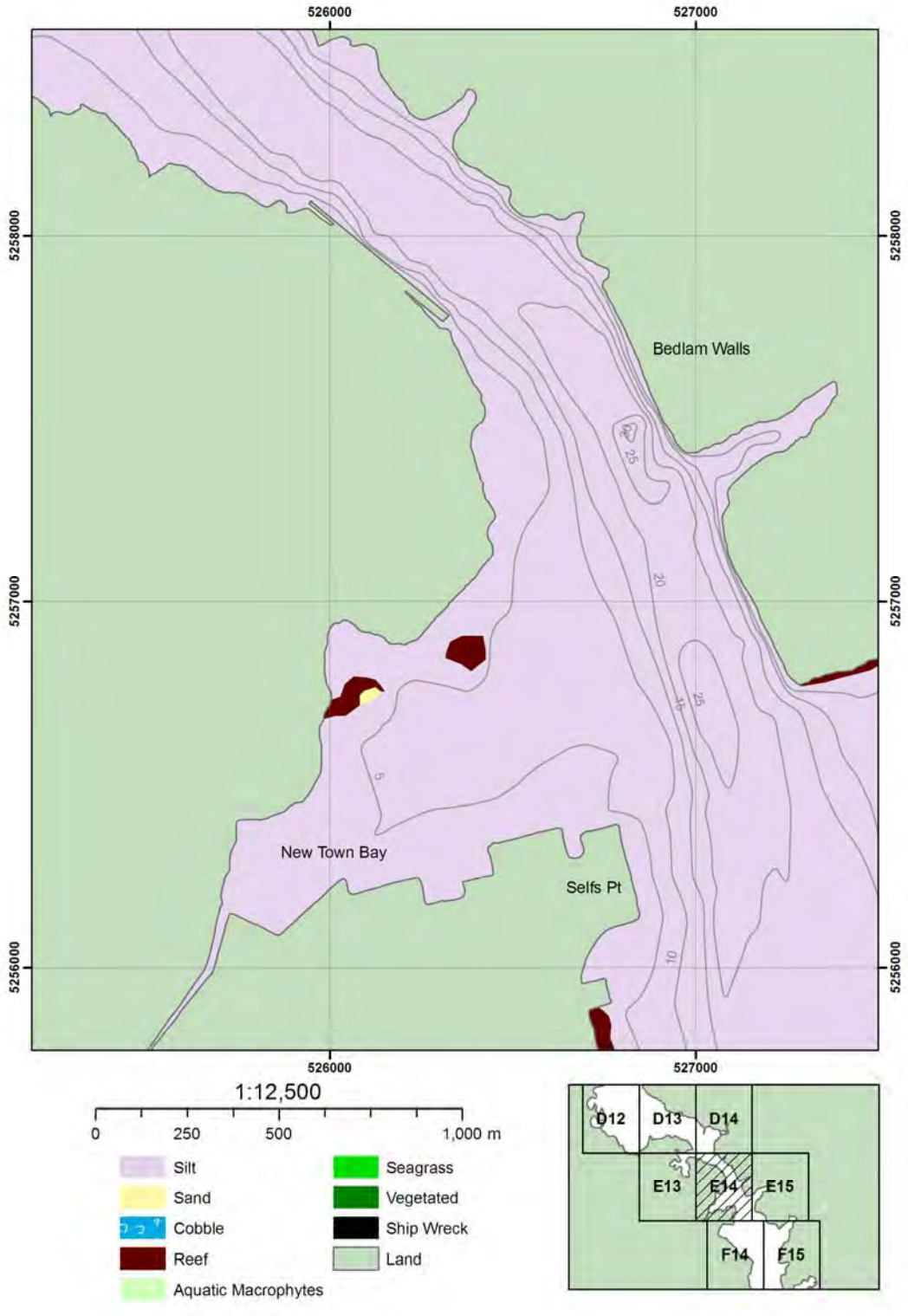
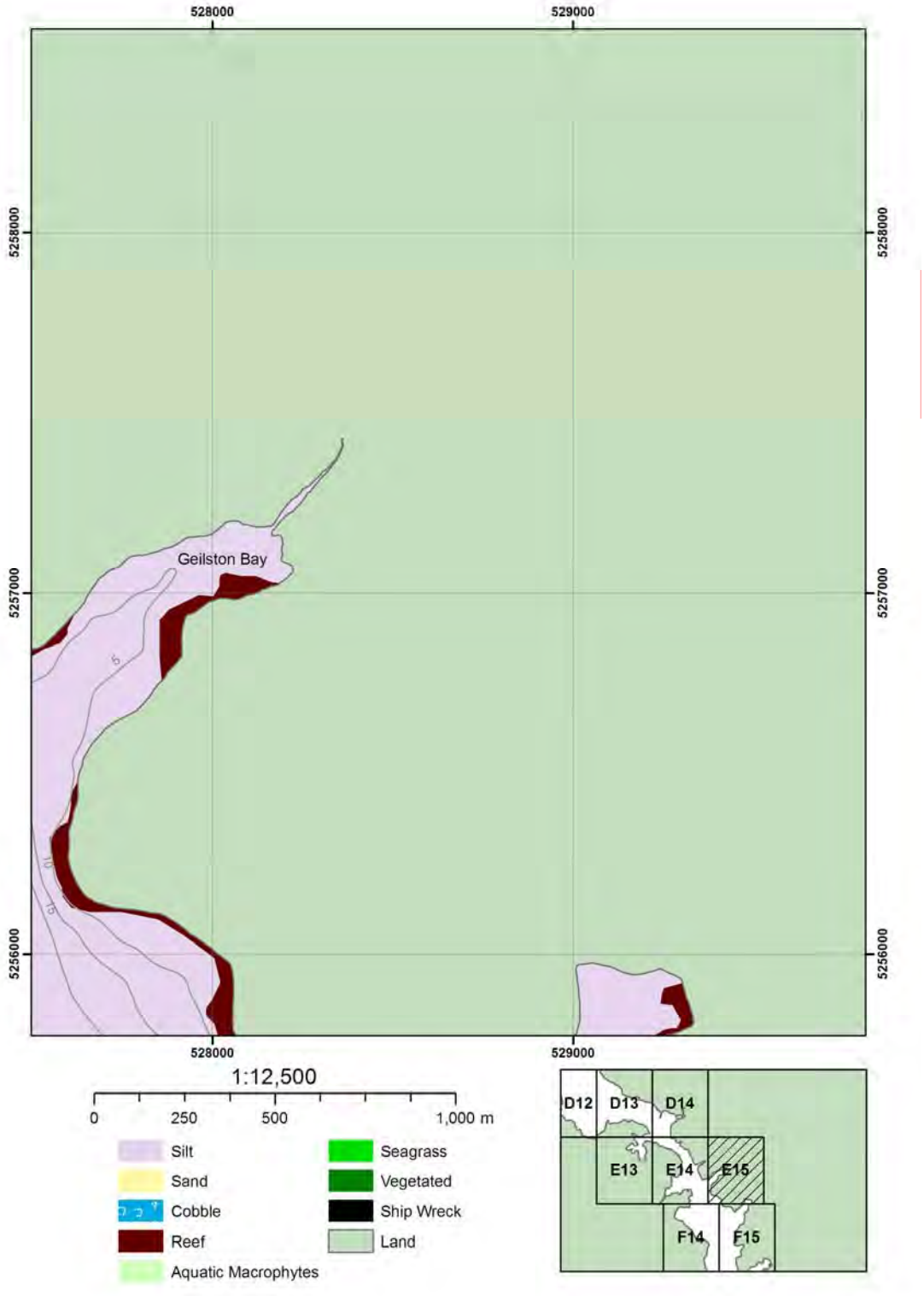
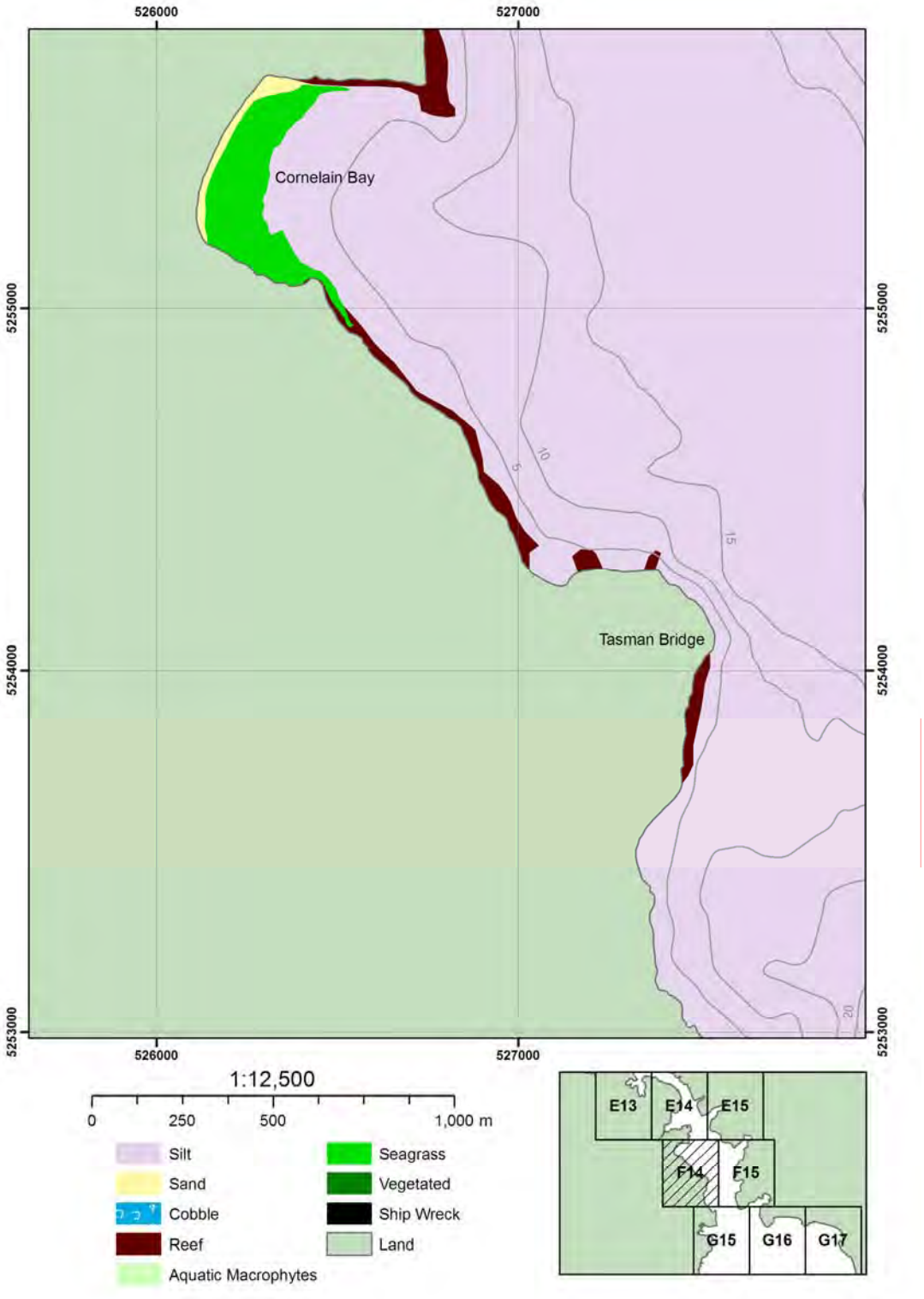
524000
525000
5258000
5257000
5256000
Prince of Wales Bay
1:12,500
0
250
500
1,000 m
Silt
Sand
Cobble
Reef
Aquatic Macrophytes
Seagrass
Vegetated
Ship Wreck
Land
D12
D13
D14
E13
E14
E15


526000
527000
5258000
5257000
5256000
Bedlam Walls
New Town Bay
Selfs Pt
25
20
15
25
5
10
1:12,500
0
250
500
1,000 m
Silt
Sand
Cobble
Reef
Aquatic Macrophytes
Seagrass
Vegetated
Ship Wreck
Land
D12
D13
D14
E13
E14
E15
F14
F15


528000
529000
5258000
5257000
5256000
Geilston Bay
5
10
15
1:12,500
0
250
500
1,000 m
Silt
Sand
Cobble
Reef
Aquatic Macrophytes
Seagrass
Vegetated
Ship Wreck
Land
D12
D13
D14
E13
E14
E15
F14
F15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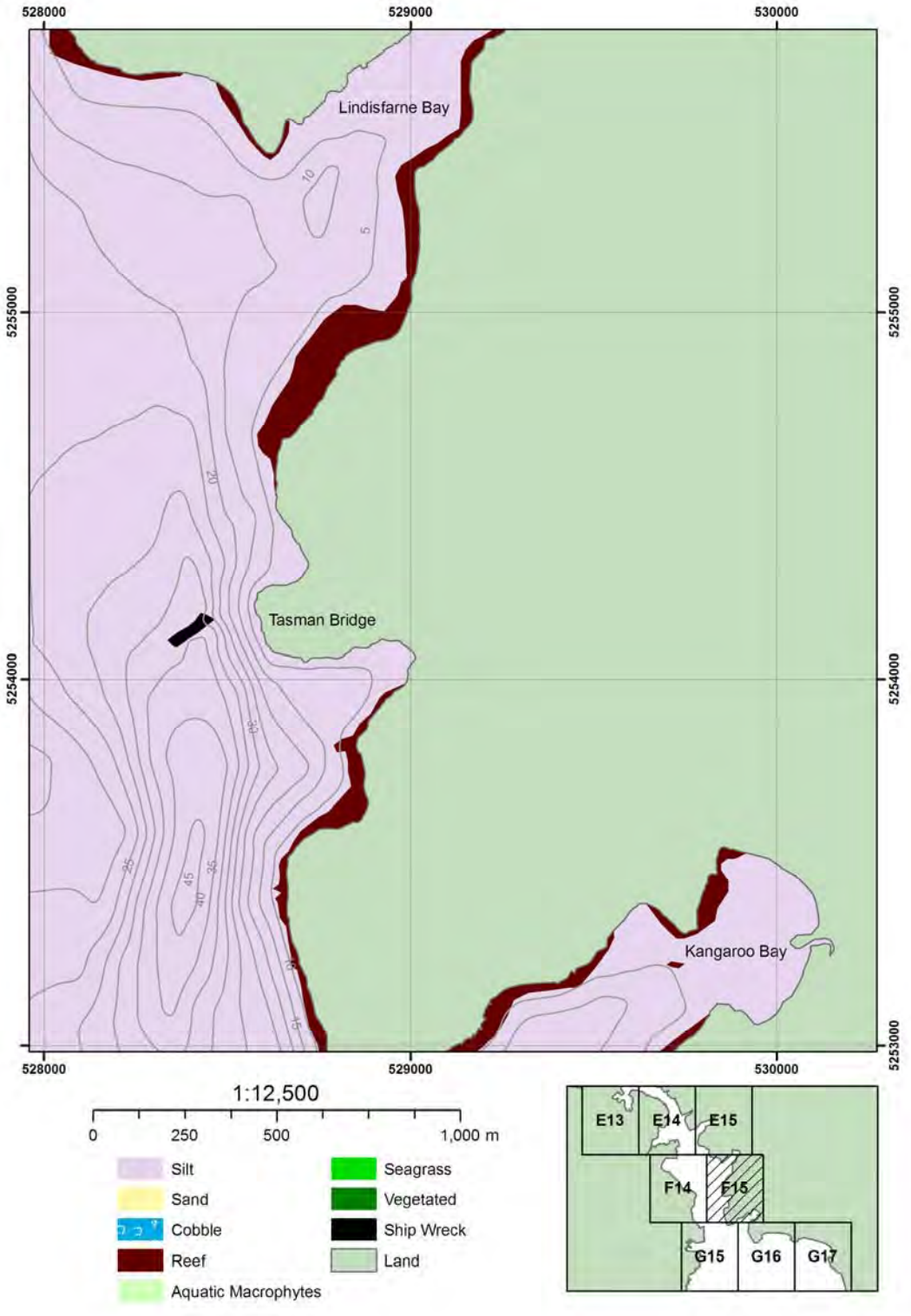
527000
5255000
5254000
5253000
Cornelain Bay
Tasman Bridge
5
10
15
20
1:12,500
0
250
500
1,000 m
Silt
Sand
Cobble
Reef
Aquatic Macrophytes
Seagrass
Vegetated
Ship Wreck
Land
E13
E14
E15
F14
F15
G15
G16
G17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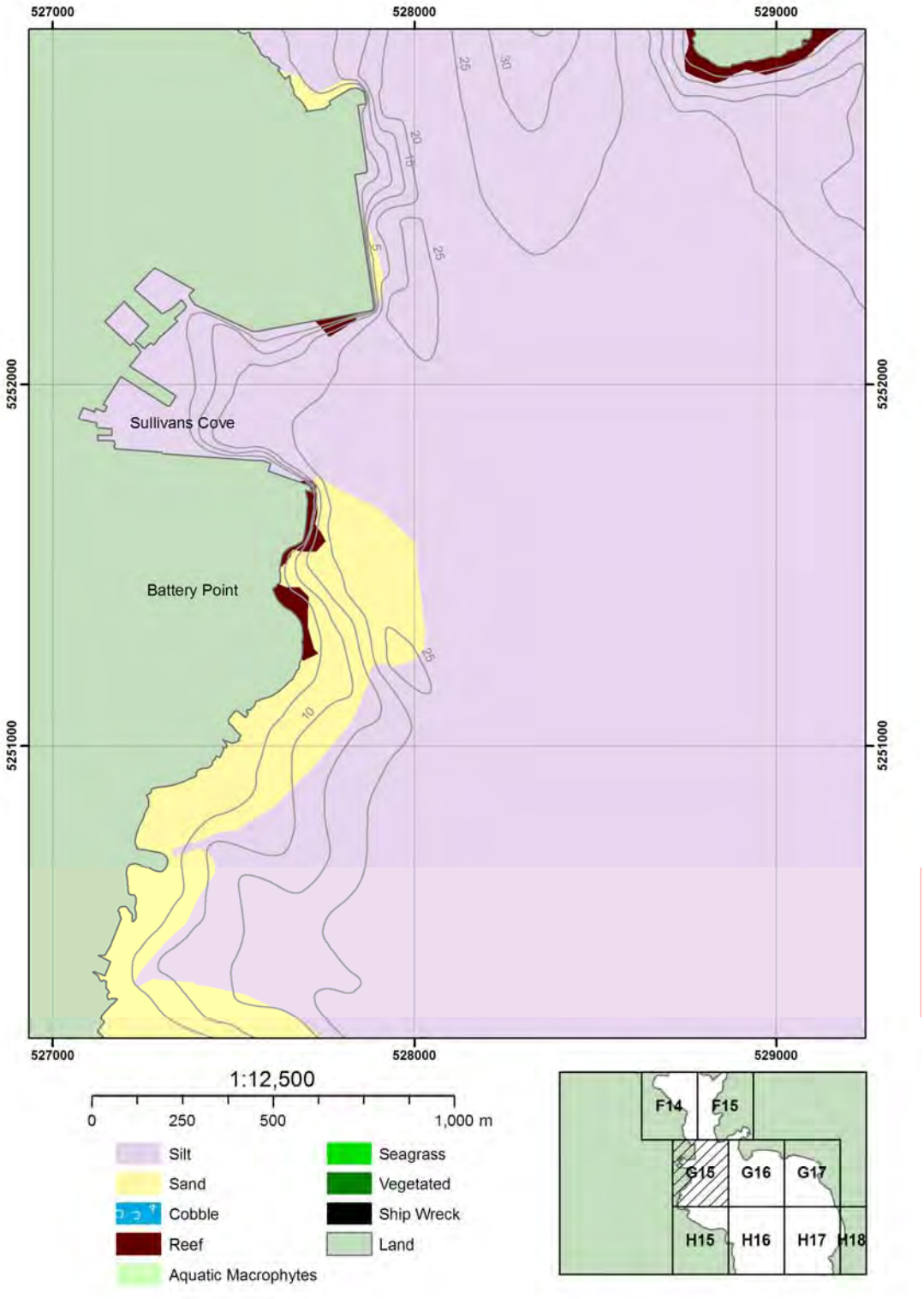
530000
5255000
5254000
5253000
Lindisfarne Bay
Tasman Bridge
Kangaroo Bay
10
5
20
30
35
45
40
1:12,500
0
250
500
1,000 m
Silt
Sand
Cobble
Reef
Aquatic Macrophytes
Seagrass
Vegetated
Ship Wreck
Land
E13
E14
E15
F14
F15
G15
G16
G17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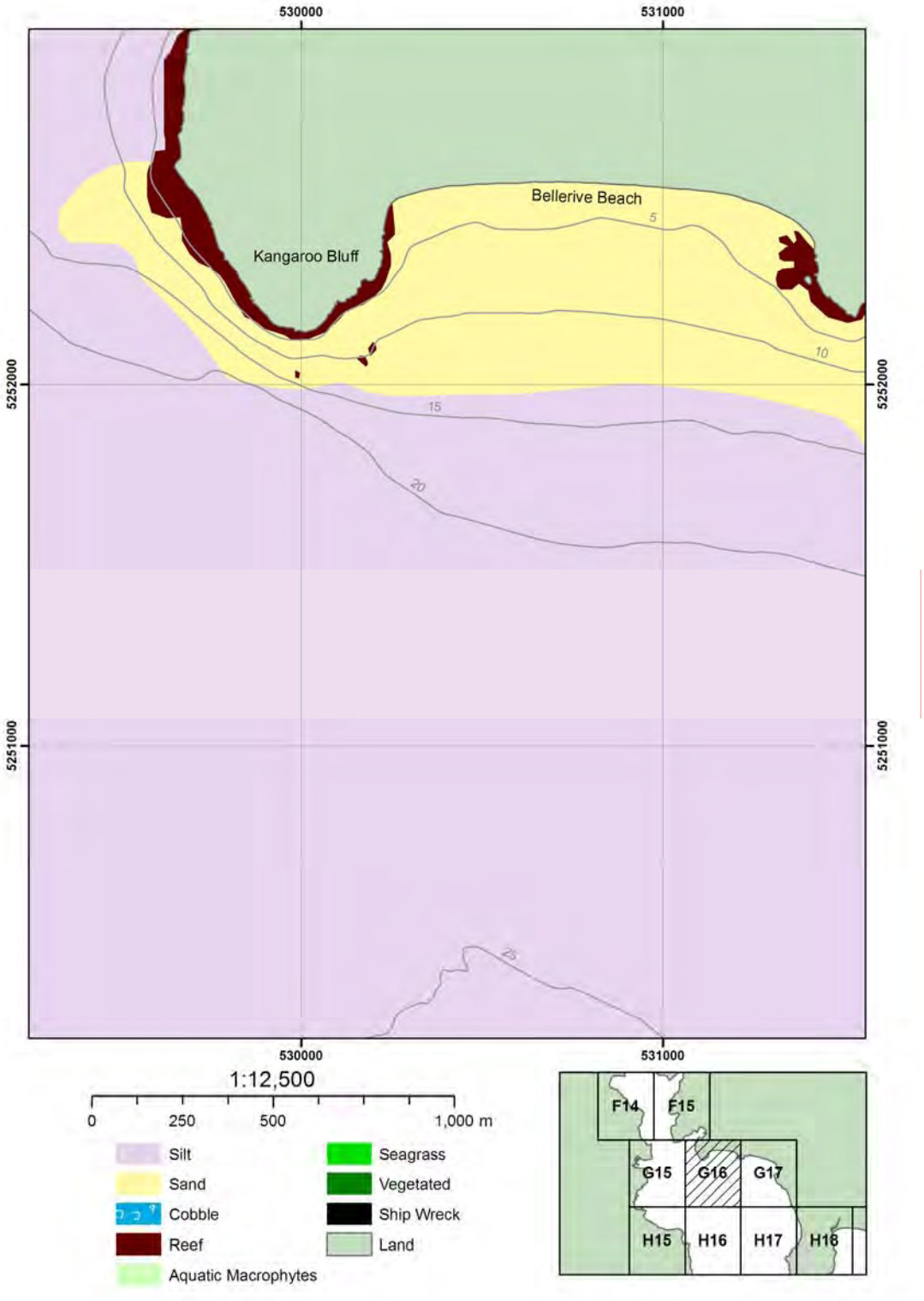
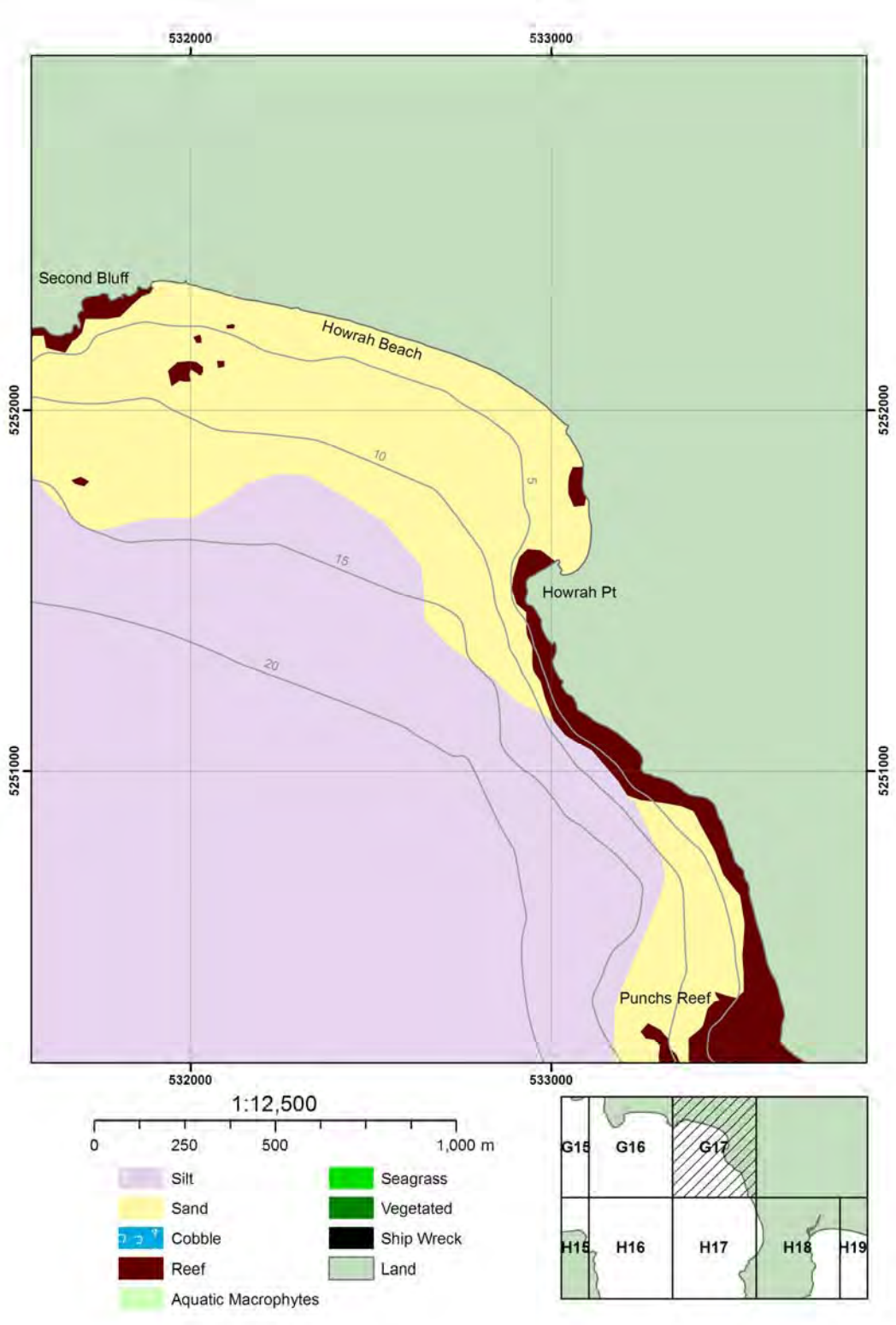
528000
529000
5252000
5251000
Sullivans Cove
Battery Point
25
30
20
5
25
25
10
1:12,500
0
250
500
1,000 m
Silt
Sand
Cobble
Reef
Aquatic Macrophytes
Seagrass
Vegetated
Ship Wreck
Land
F14
F15
G15
G16
G17
H15
H16
H17
H18


530000
531000
5252000
5251000
Bellerive Beach
Kangaroo Bluff
5
10
15
20
25
1:12,500
0
250
500
1,000 m
Silt
Sand
Cobble
Reef
Aquatic Macrophytes
Seagrass
Vegetated
Ship Wreck
Land
F14
F15
G15
G16
G17
H15
H16
H17
H18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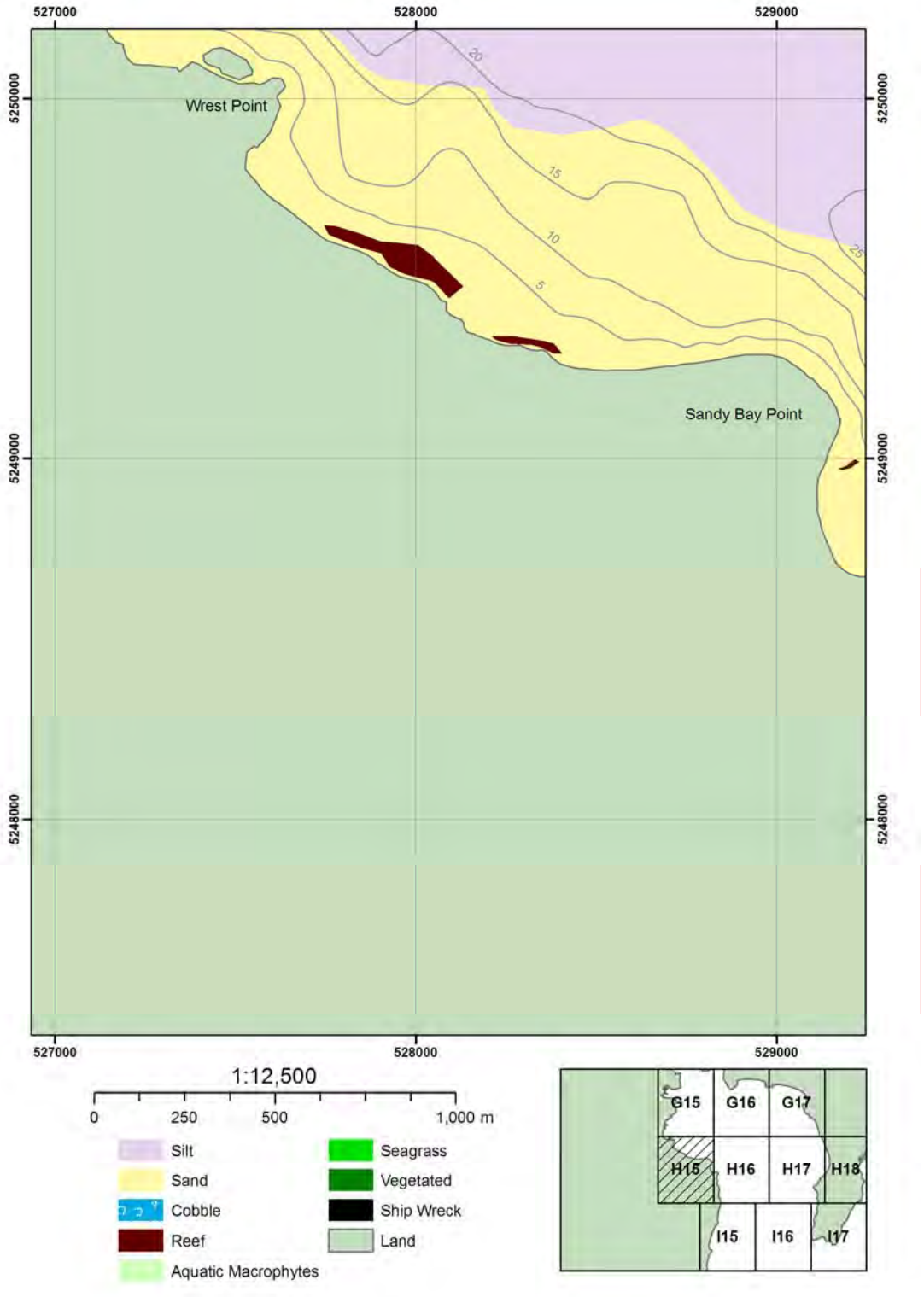
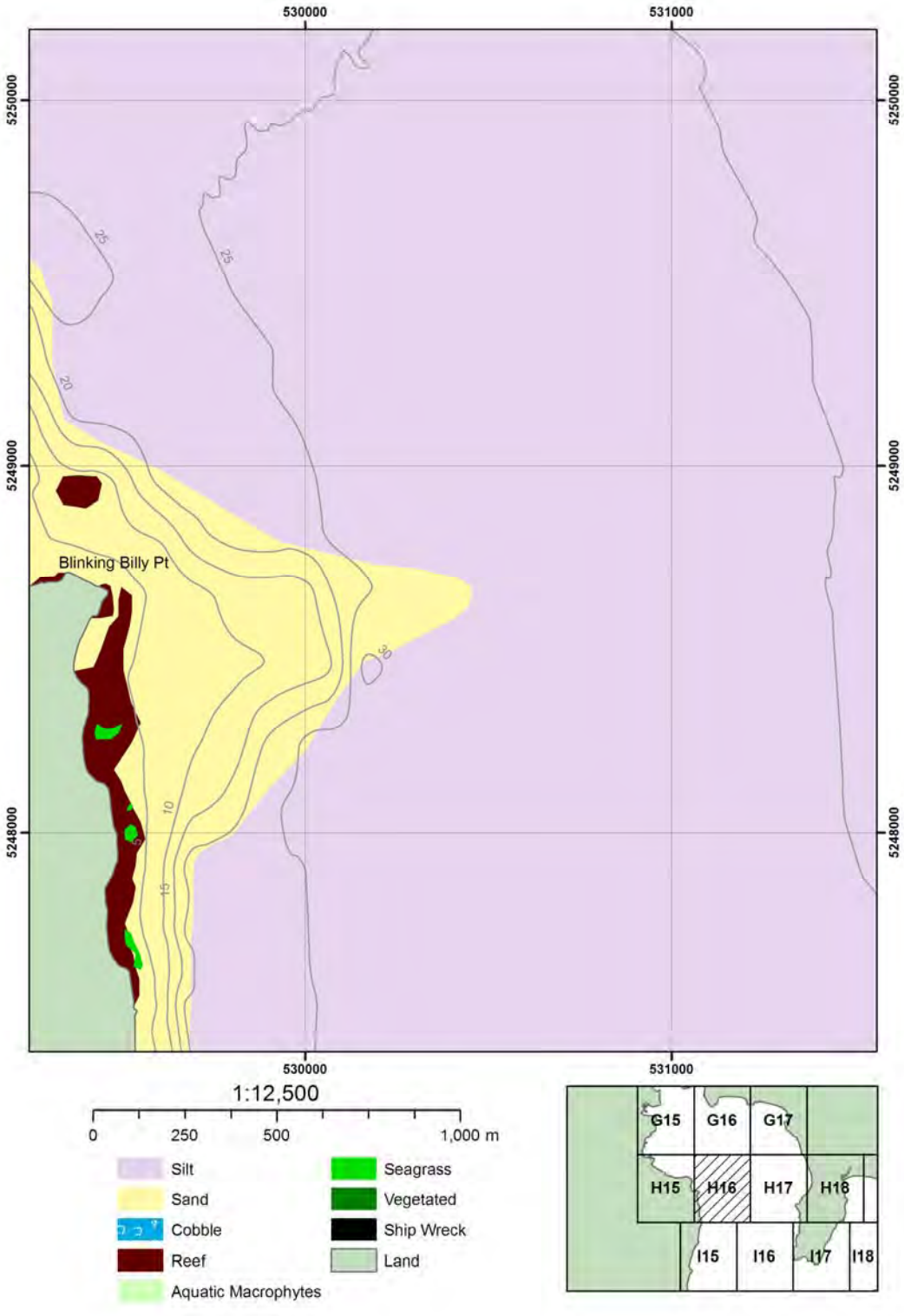
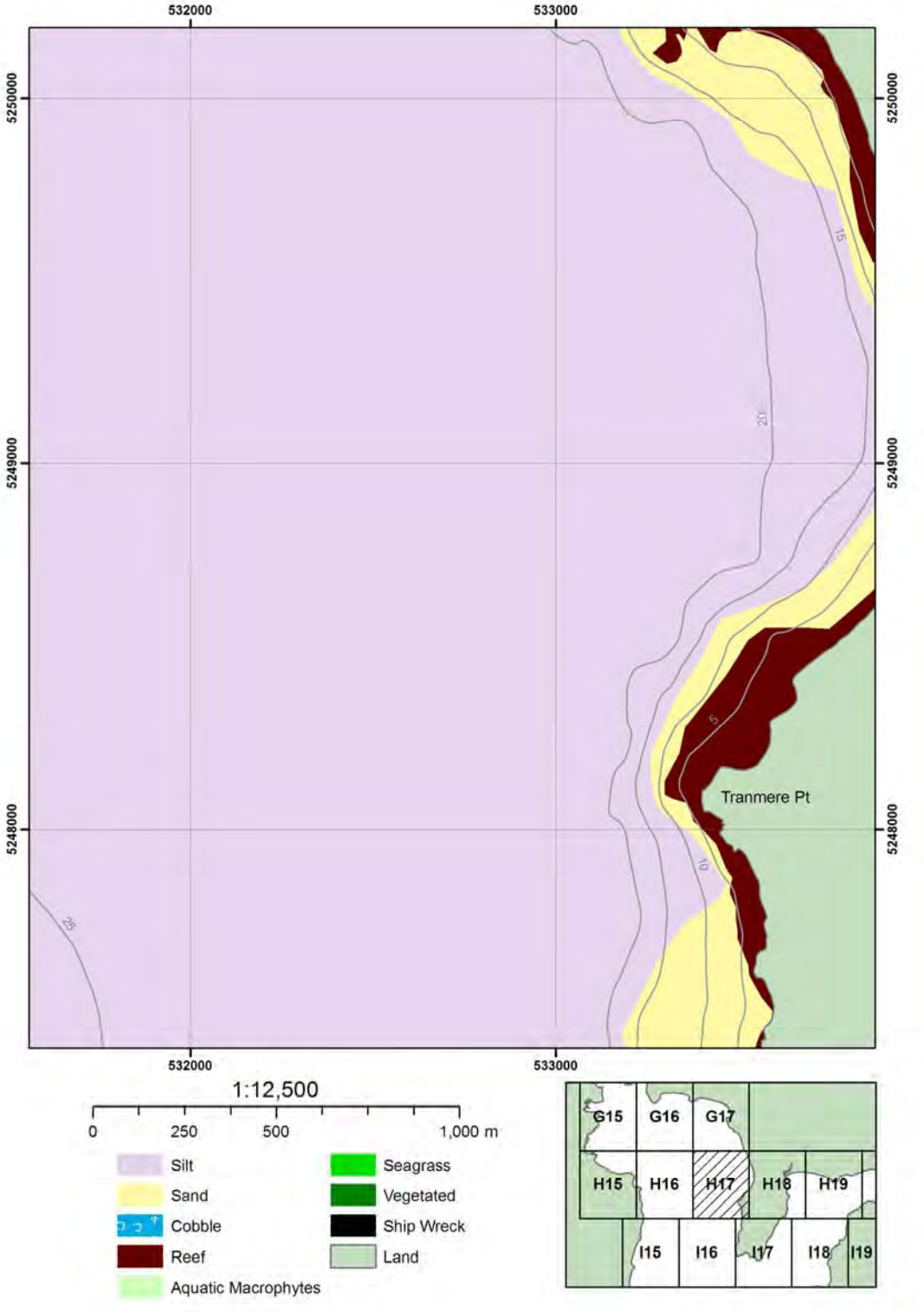
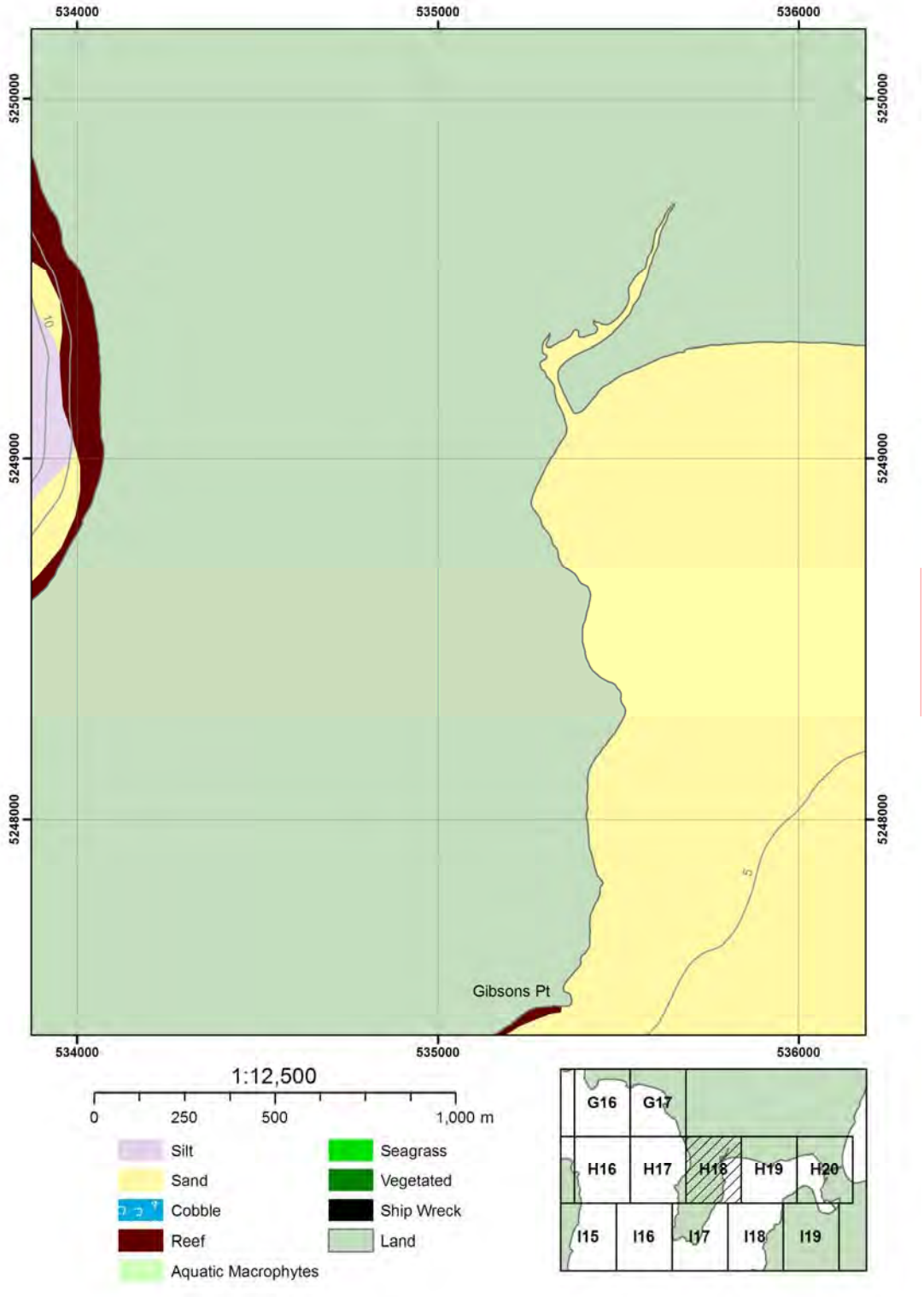
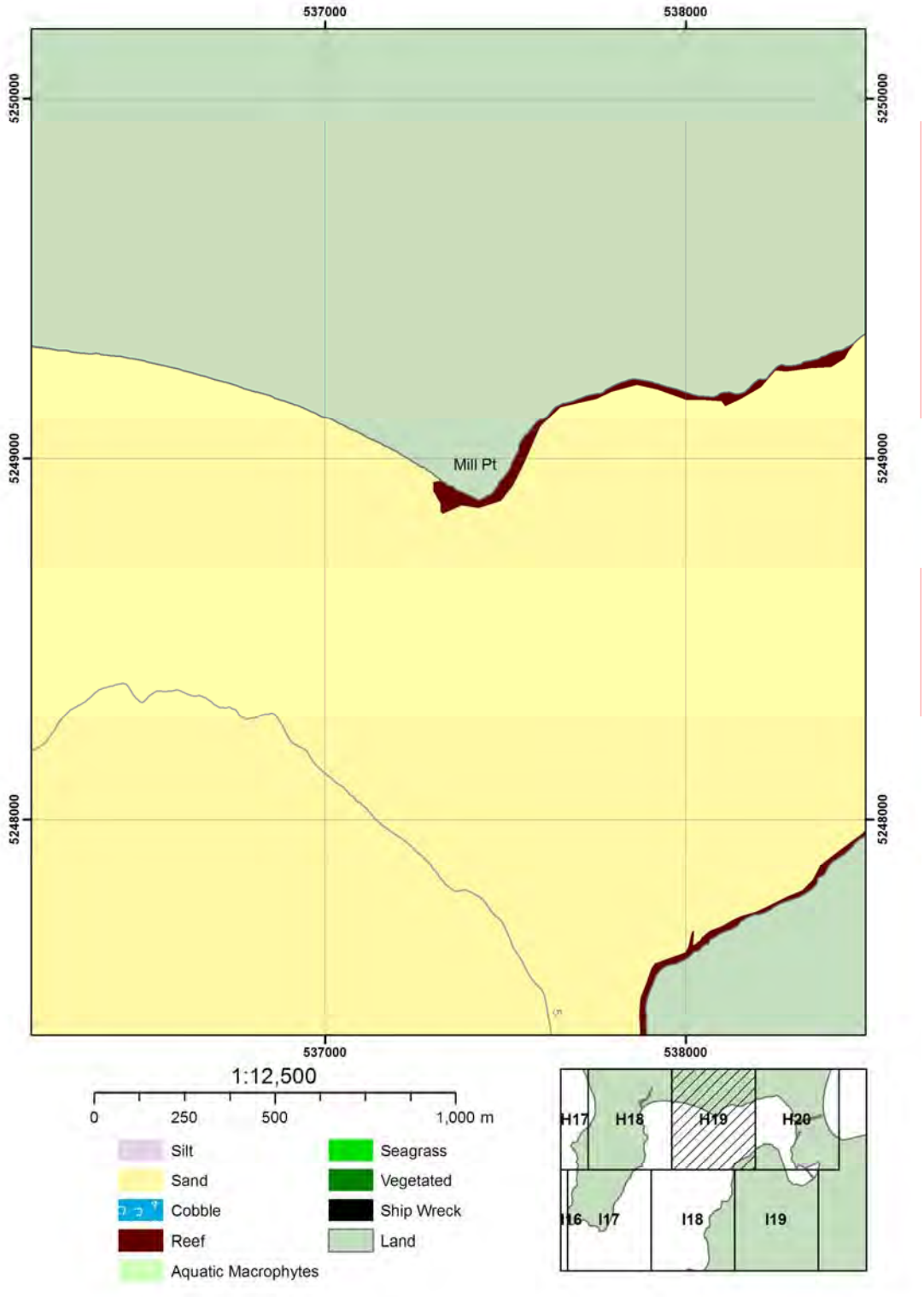
533000
5252000
5251000
Second Bluff
Howrah Beach
Howrah Pt
Punchs Reef
10
5
15
20
1:12,500
0
250
500
1,000 m
Silt
Sand
Cobble
Reef
Aquatic Macrophytes
Seagrass
Vegetated
Ship Wreck
Land
G15
G16
G17
H15
H16
H17
H18
H19

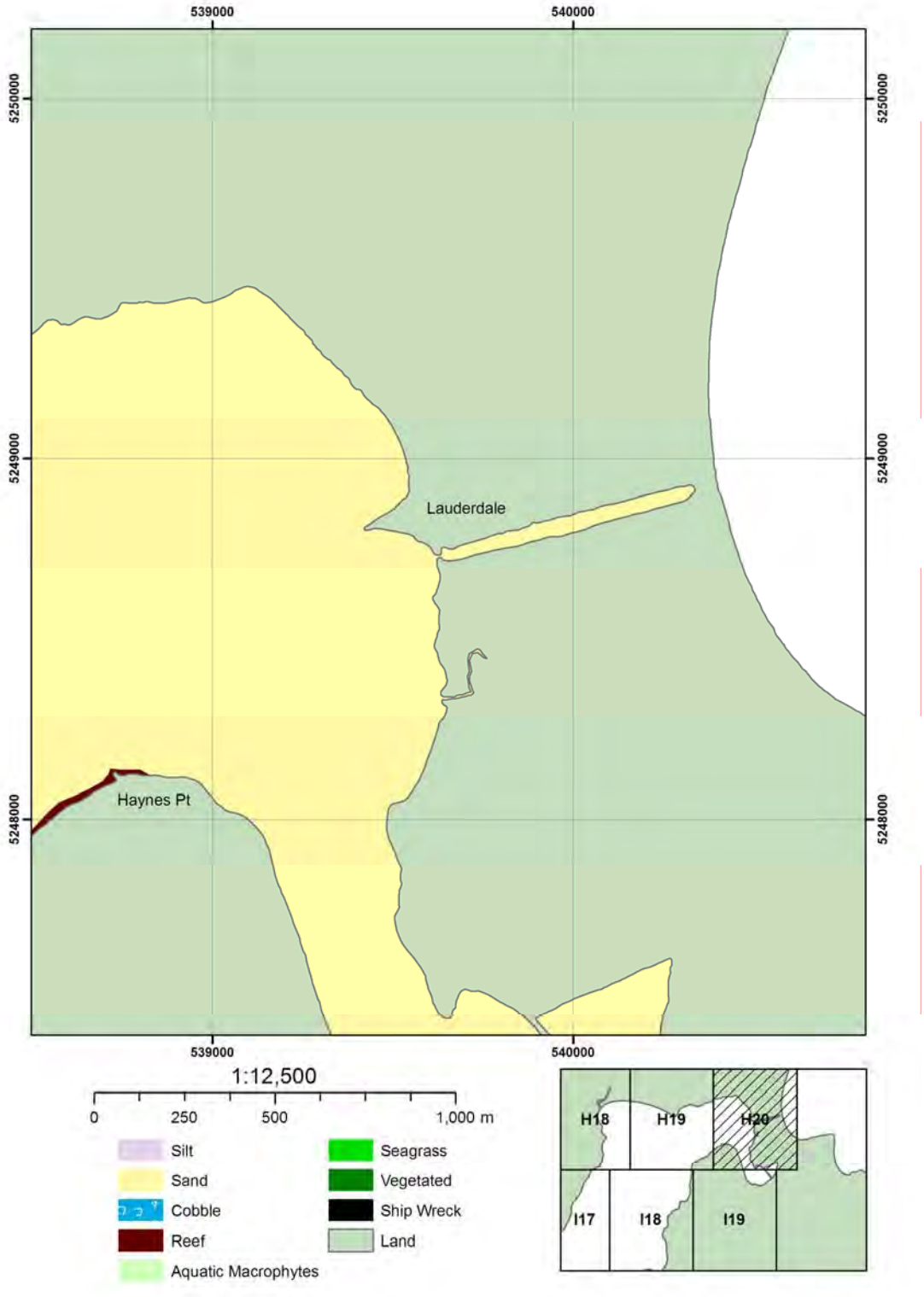

527000
528000
529000
5250000
5249000
5248000
Wrest Point
Sandy Bay Point
20
15
10
5
25
1:12,500
0
250
500
1,000 m
Silt
Sand
Cobble
Reef
Aquatic Macrophytes
Seagrass
Vegetated
Ship Wreck
Land
G15
G16
G17
H15
H16
H17
H18
I15
I16
I17

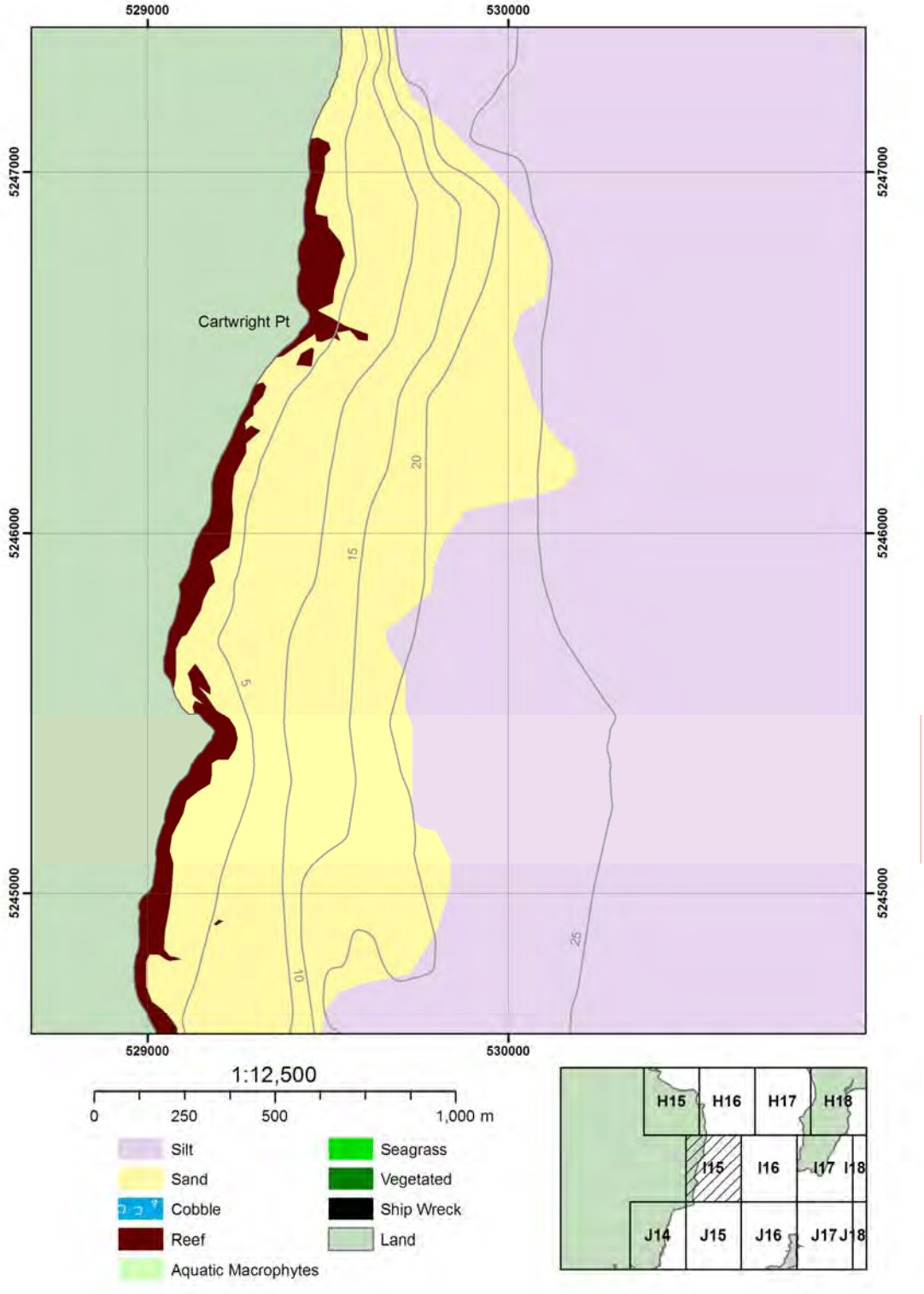

530000
531000
5250000
5249000
5248000
Blinking Billy Pt
25
20
10
5
1:12,500
0
250
500
1,000 m
Silt
Sand
Cobble
Reef
Aquatic Macrophytes
Seagrass
Vegetated
Ship Wreck
Land
G15
G16
G17
H15
H16
H17
H18
I15
I16
I17
I18


532000
533000
5250000
5249000
5248000
Tranmere Pt
1:12,500
0
250
500
1,000 m
Silt
Sand
Cobble
Reef
Aquatic Macrophytes
Seagrass
Vegetated
Ship Wreck
Land
G15
G16
G17
H15
H16
H17
H18
H19
I15
I16
I17
I18
I19


534000
535000
536000
5250000
5249000
5248000
10
5
Gibsons Pt
1:12,500
0
250
500
1,000 m
Silt
Sand
Cobble
Reef
Aquatic Macrophytes
Seagrass
Vegetated
Ship Wreck
Land
G16
G17
H16
H17
H18
H19
H20
I15
I16
I17
I18
I19


537000
538000
5250000
5249000
5248000
Mill Pt
1:12,500
0
250
500
1,000 m
Silt
Sand
Cobble
Reef
Aquatic Macrophytes
Seagrass
Vegetated
Ship Wreck
Land
H17
H18
H19
H20
I16
I17
I18
I19


539000
540000
5250000
5249000
5248000
Lauderdale
Haynes Pt
1:12,500
0
250
500
1,000 m
Silt
Sand
Cobble
Reef
Aquatic Macrophytes
Seagrass
Vegetated
Ship Wreck
Land
H18
H19
H20
I17
I18
I19


529000
530000
5247000
5246000
5245000
Cartwright Pt
20
15
5
10
25
1:12,500
0
250
500
1,000 m
Silt
Sand
Cobble
Reef
Aquatic Macrophytes
Seagrass
Vegetated
Ship Wreck
Land
H15
H16
H17
H18
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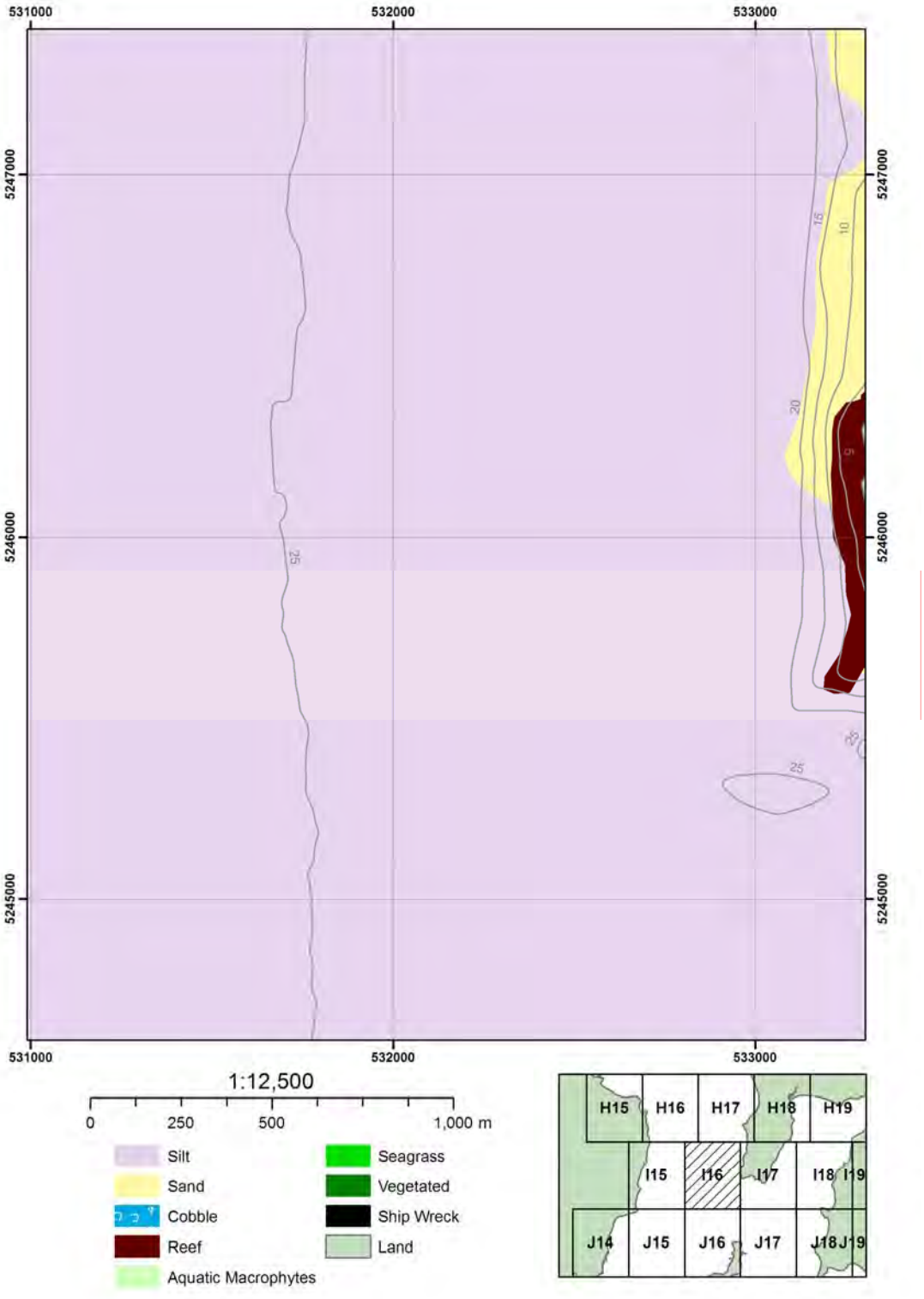
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Vegetated
Ship Wreck
Land
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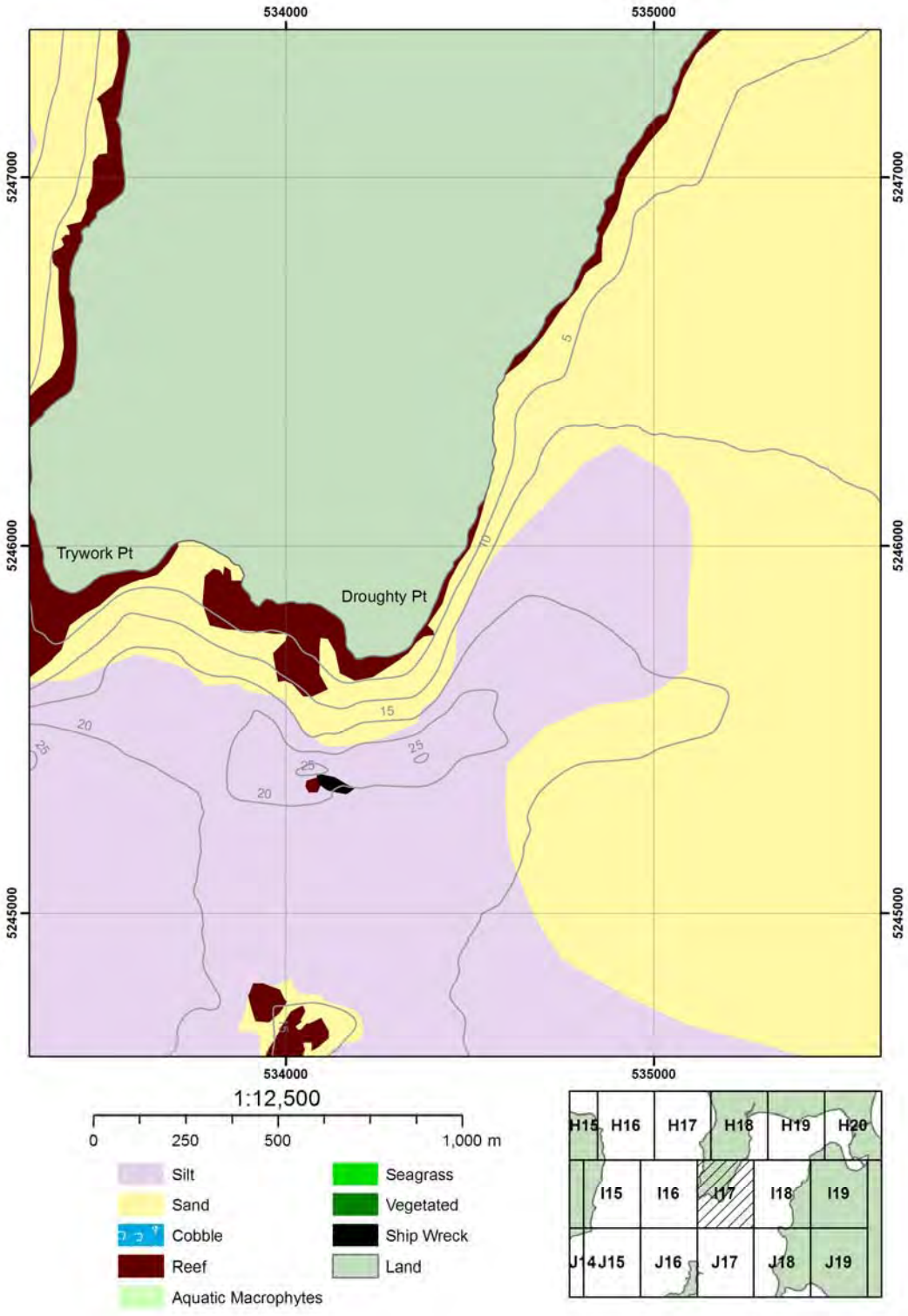
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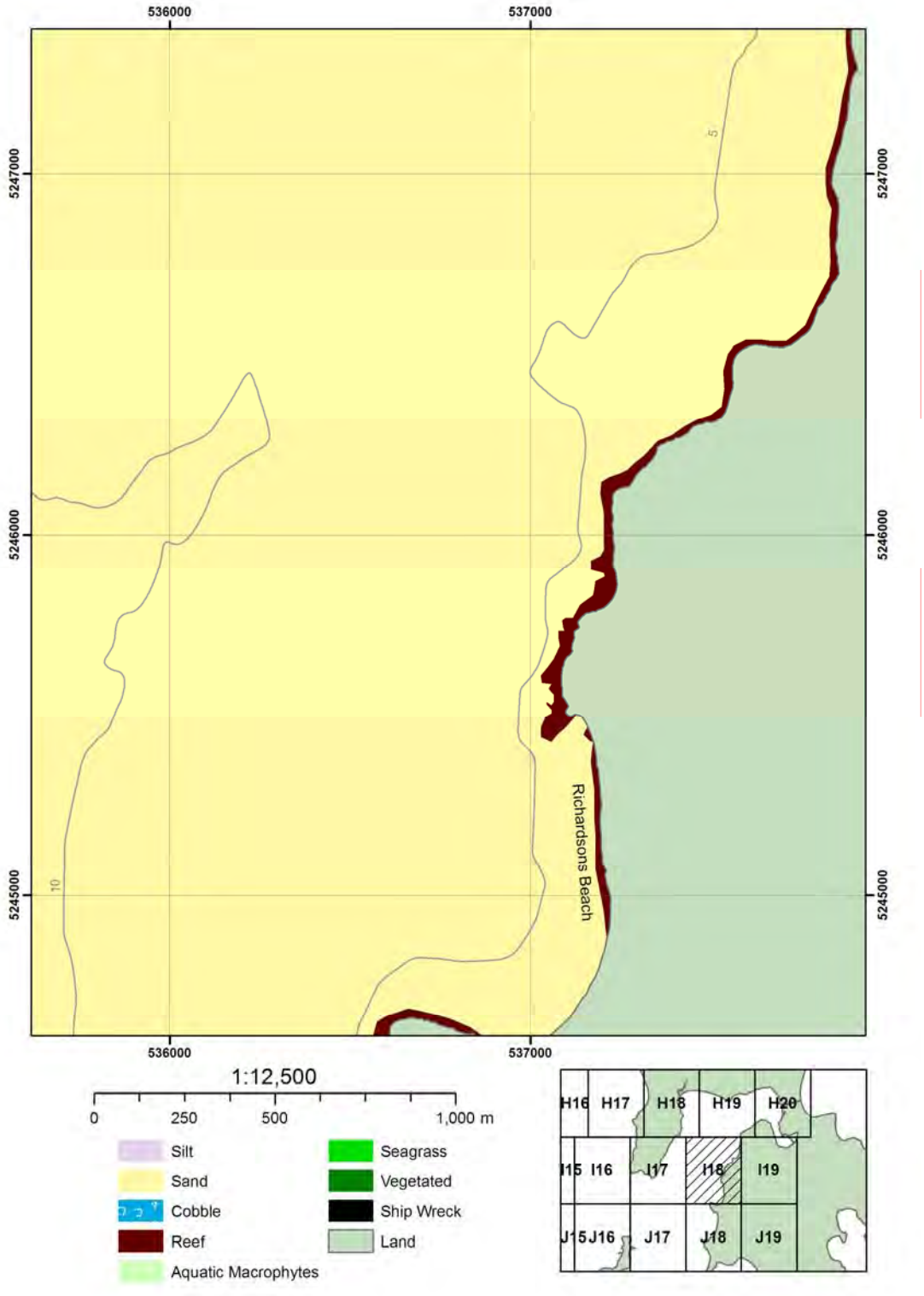
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Vegetated
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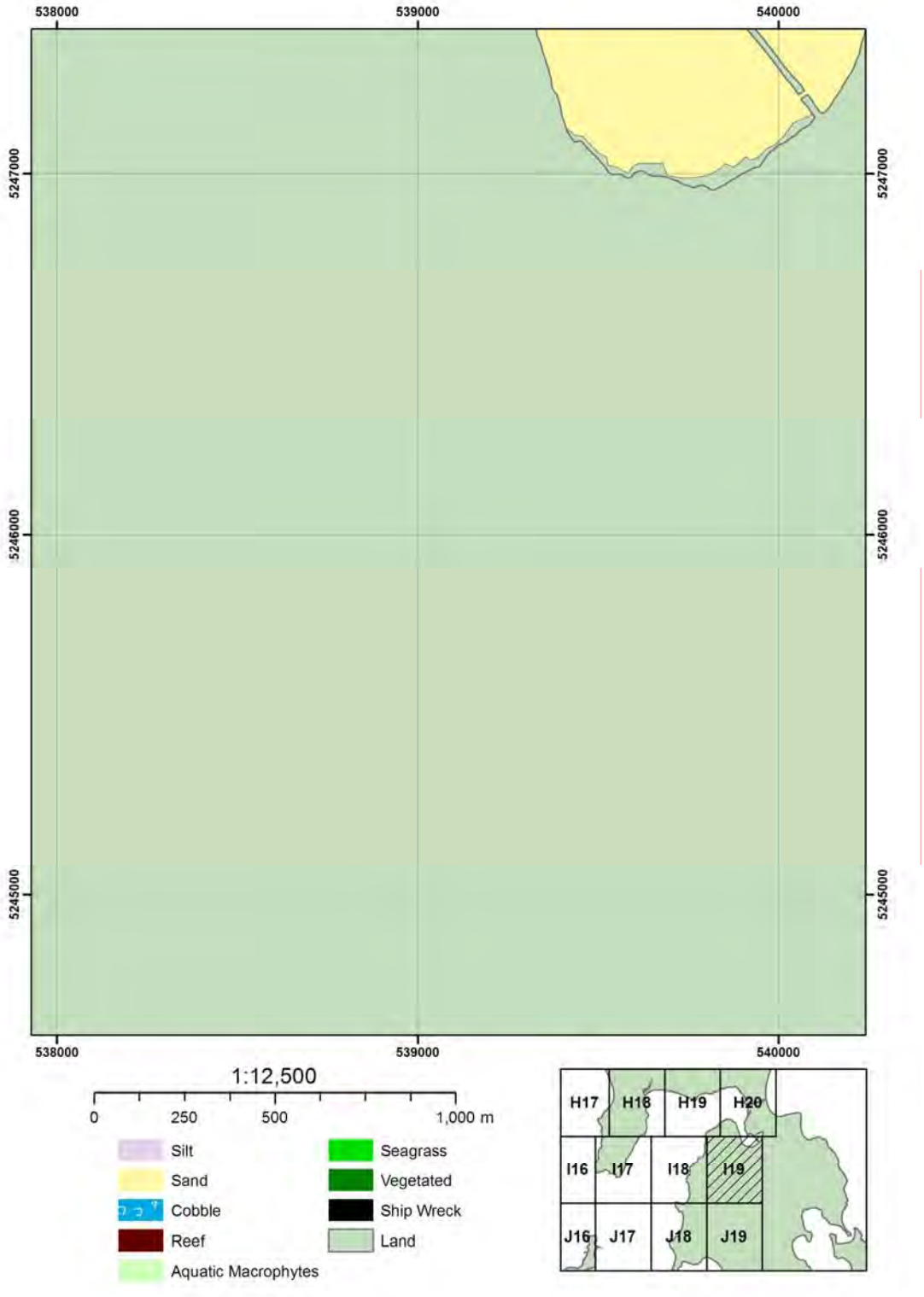
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Ship Wreck
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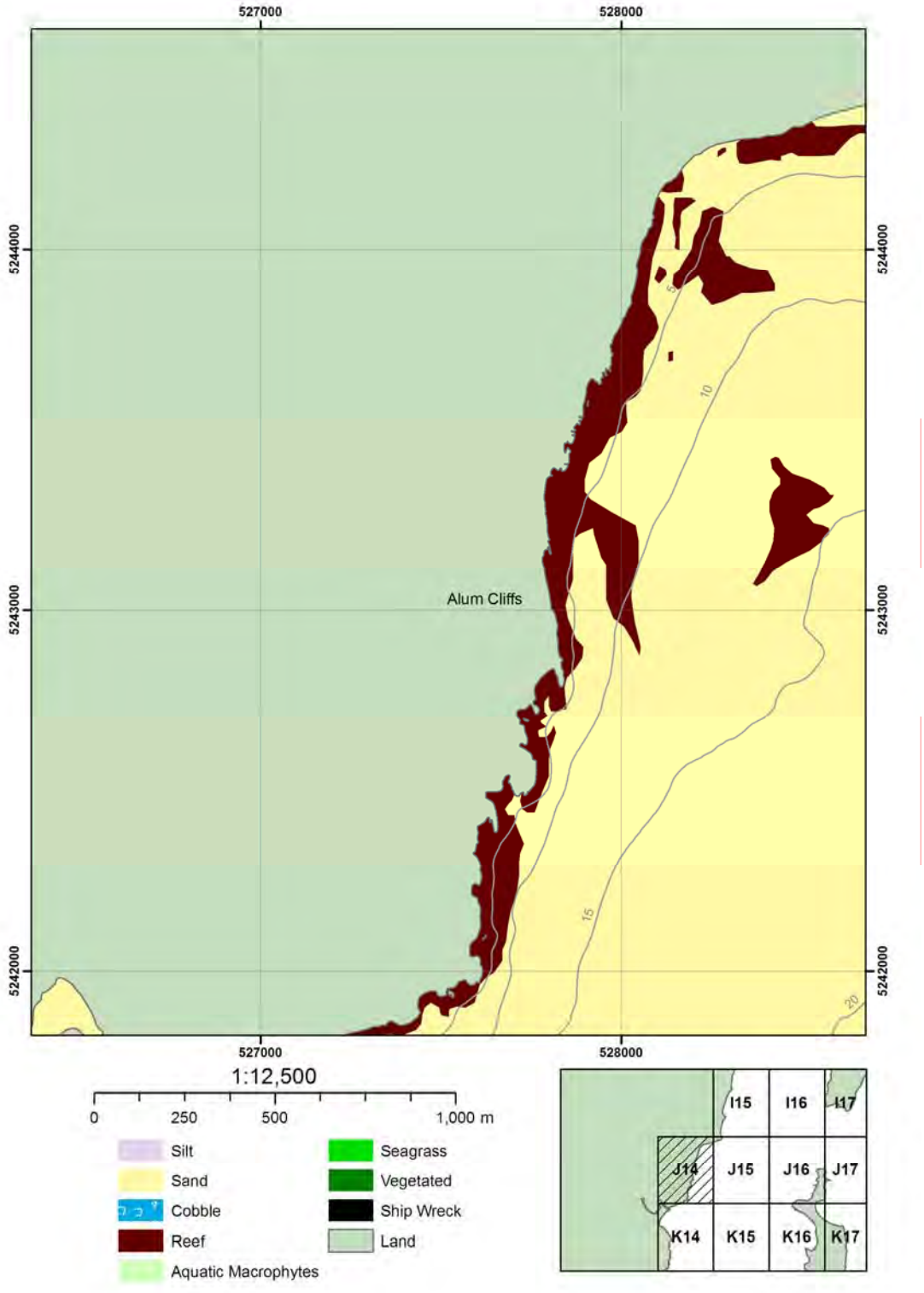
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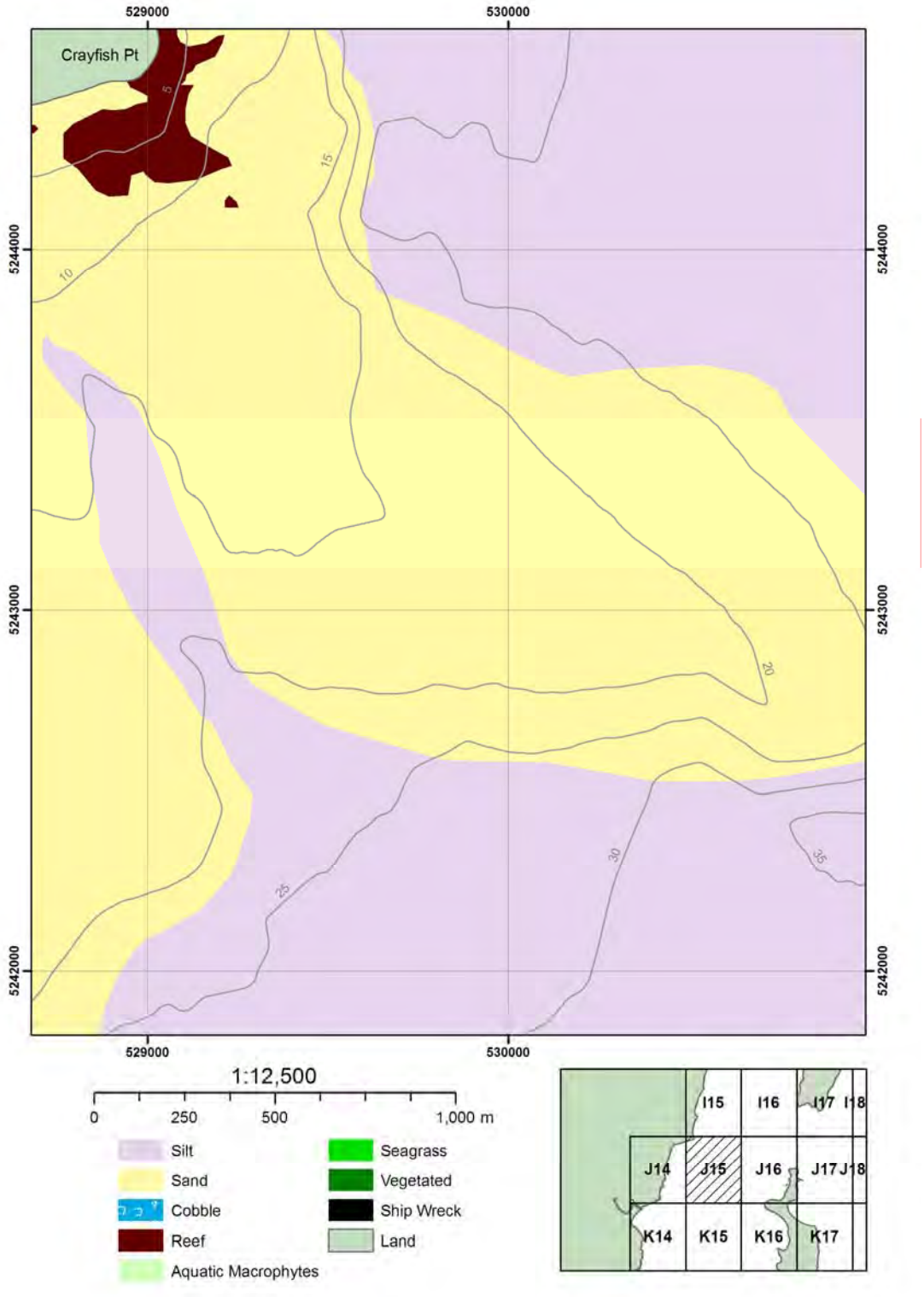
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Reef
Aquatic Macrophytes
Seagrass
Vegetated
Ship Wreck
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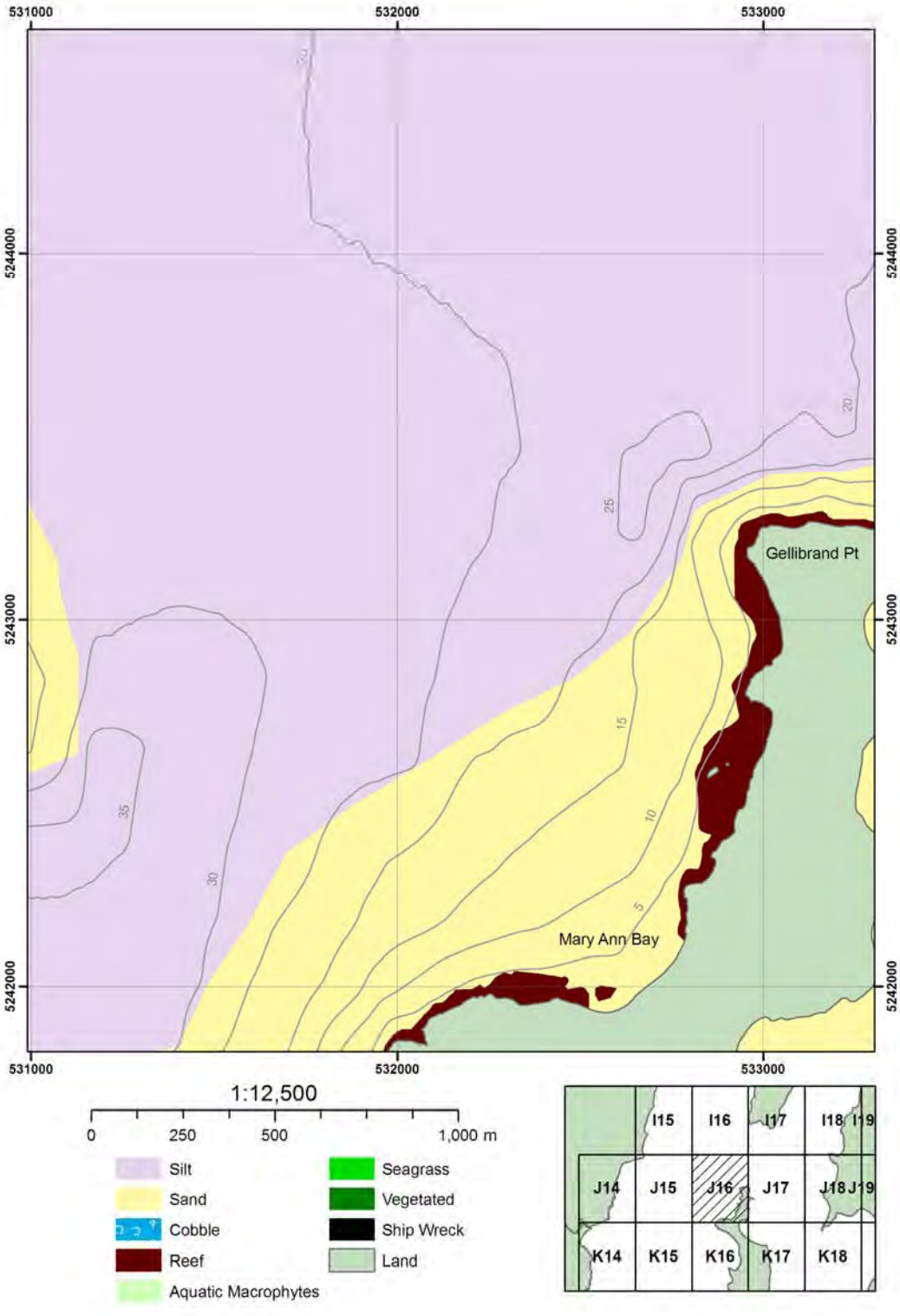
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Cobble
Reef
Aquatic Macrophytes
Seagrass
Vegetated
Ship Wreck
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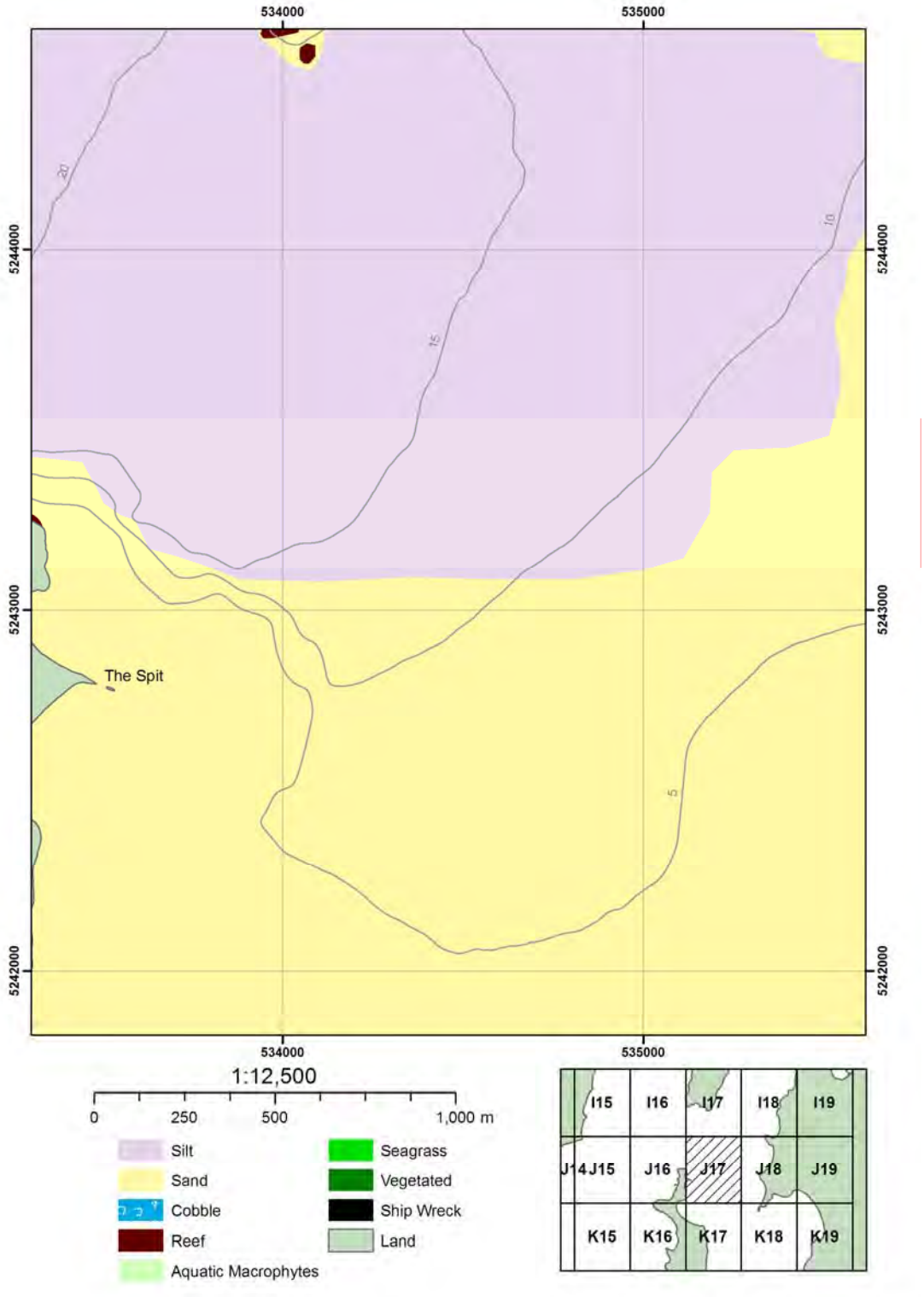
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Cobble
Reef
Aquatic Macrophytes
Seagrass
Vegetated
Ship Wreck
Land
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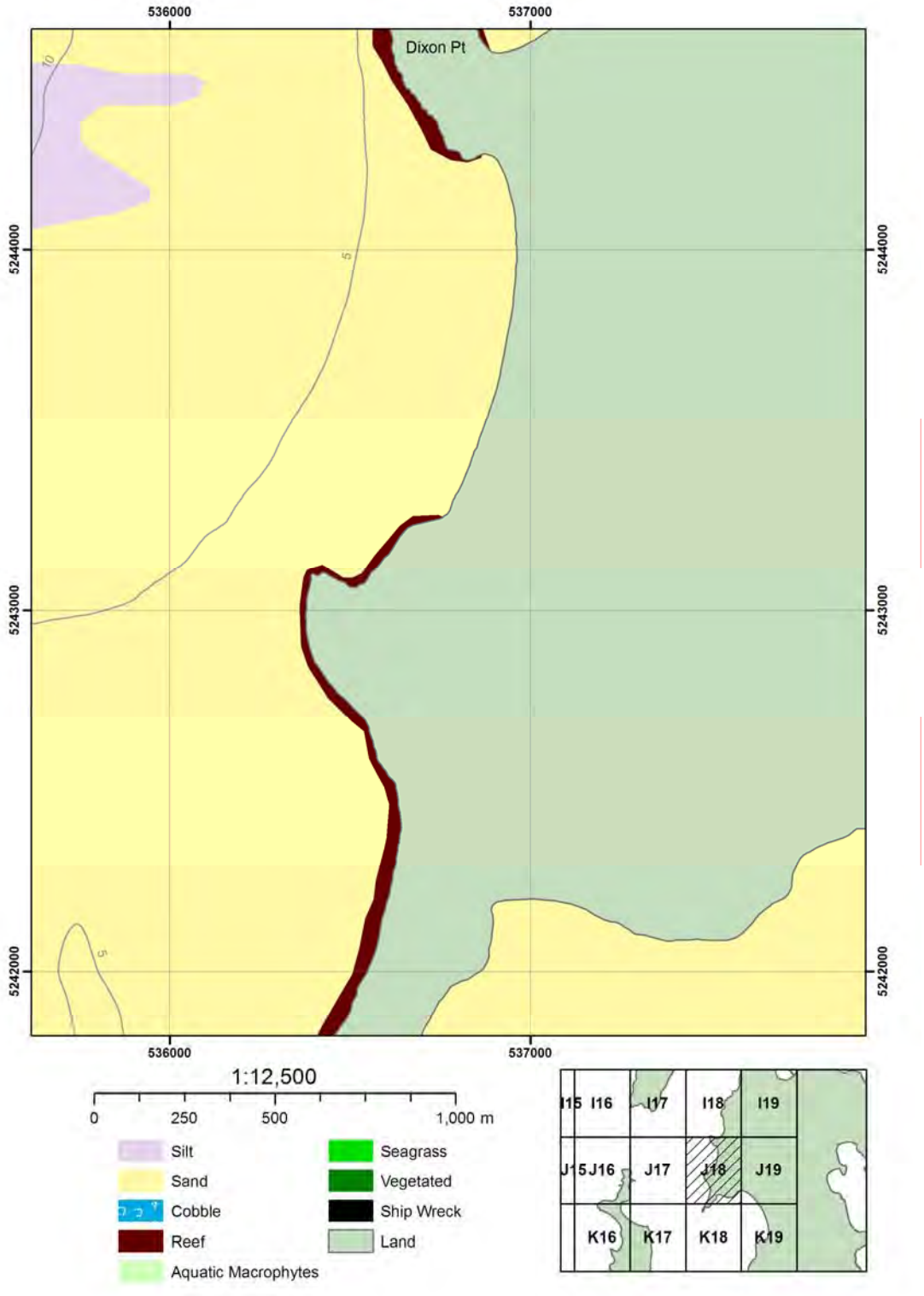
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Cobble
Reef
Aquatic Macrophytes
Seagrass
Vegetated
Ship Wreck
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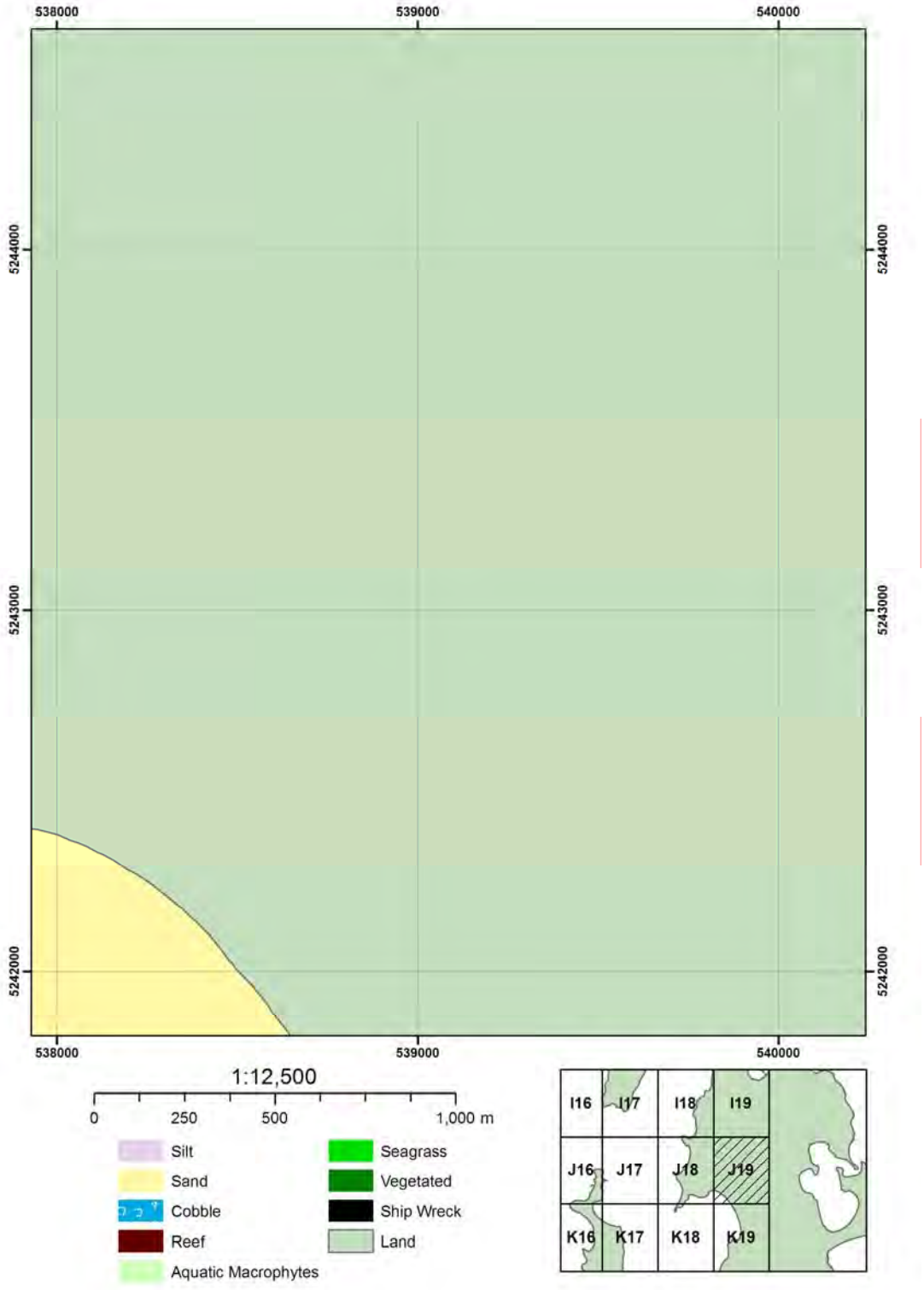
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Silt
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Cobble
Reef
Aquatic Macrophytes
Seagrass
Vegetated
Ship Wreck
Land
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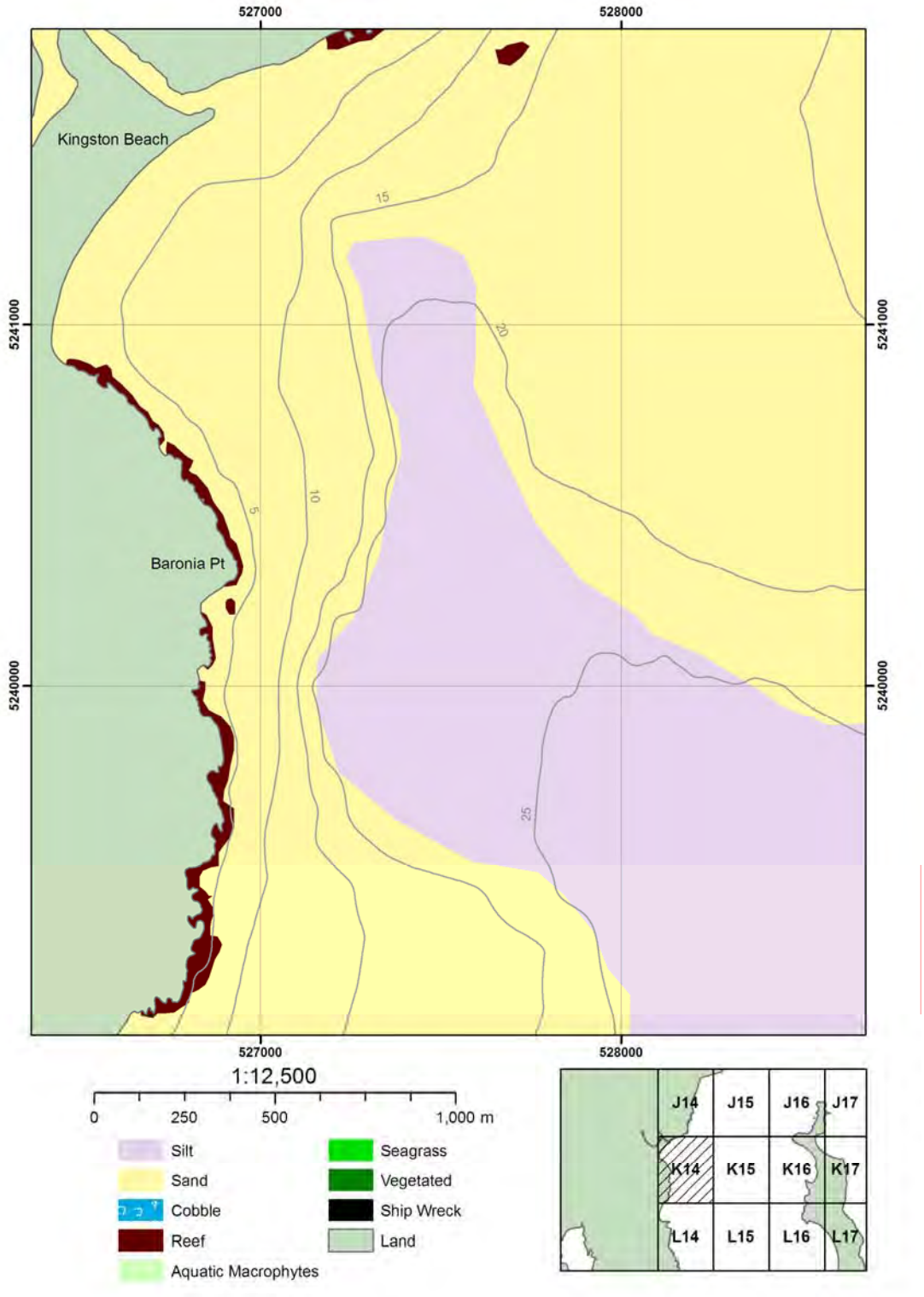
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Baronia Pt
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Silt
Sand
Cobble
Reef
Aquatic Macrophytes
Seagrass
Vegetated
Ship Wreck
Land
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L16
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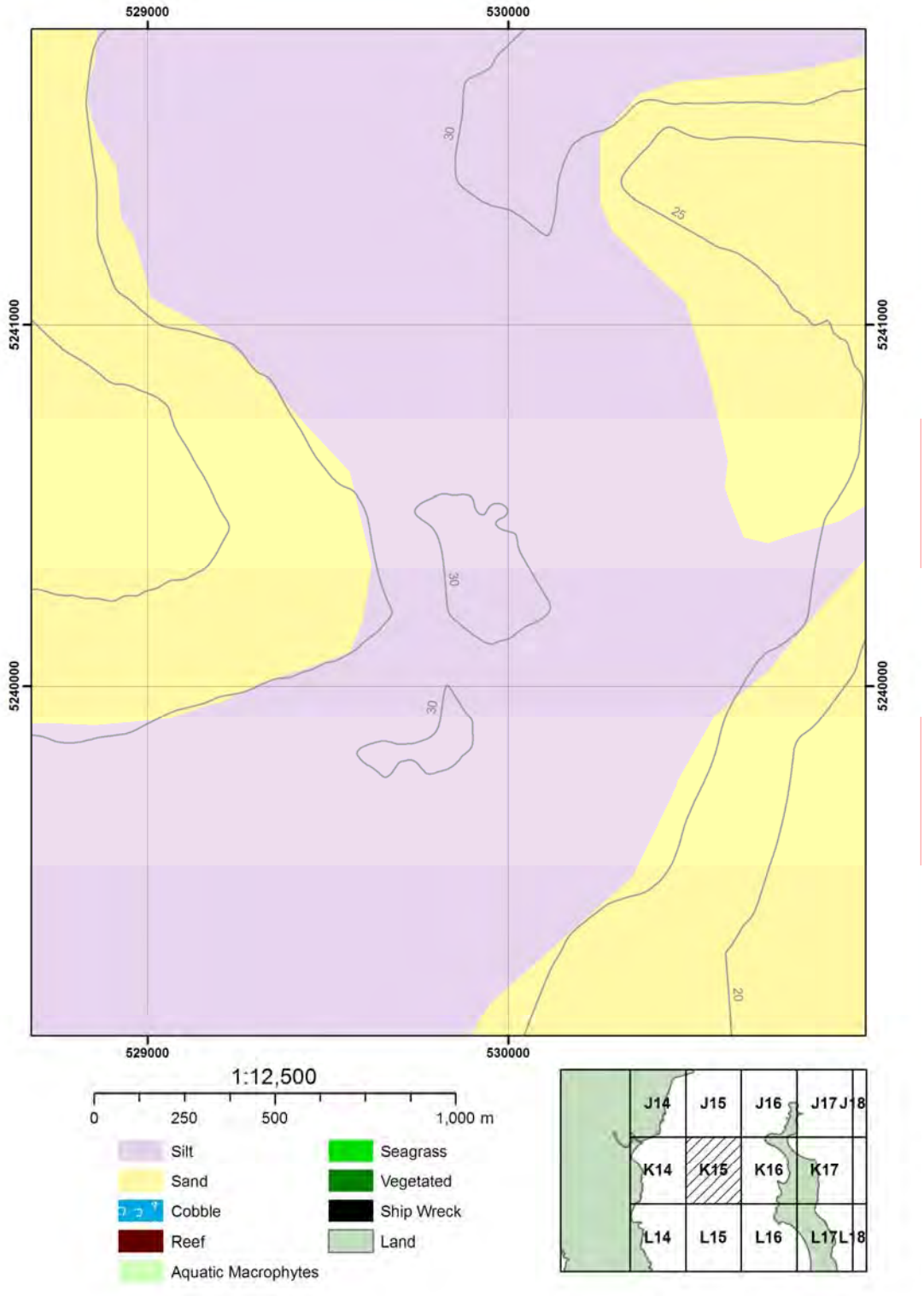
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Silt
Sand
Cobble
Reef
Aquatic Macrophytes
Seagrass
Vegetated
Ship Wreck
Land
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J17
J18
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K15
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K17
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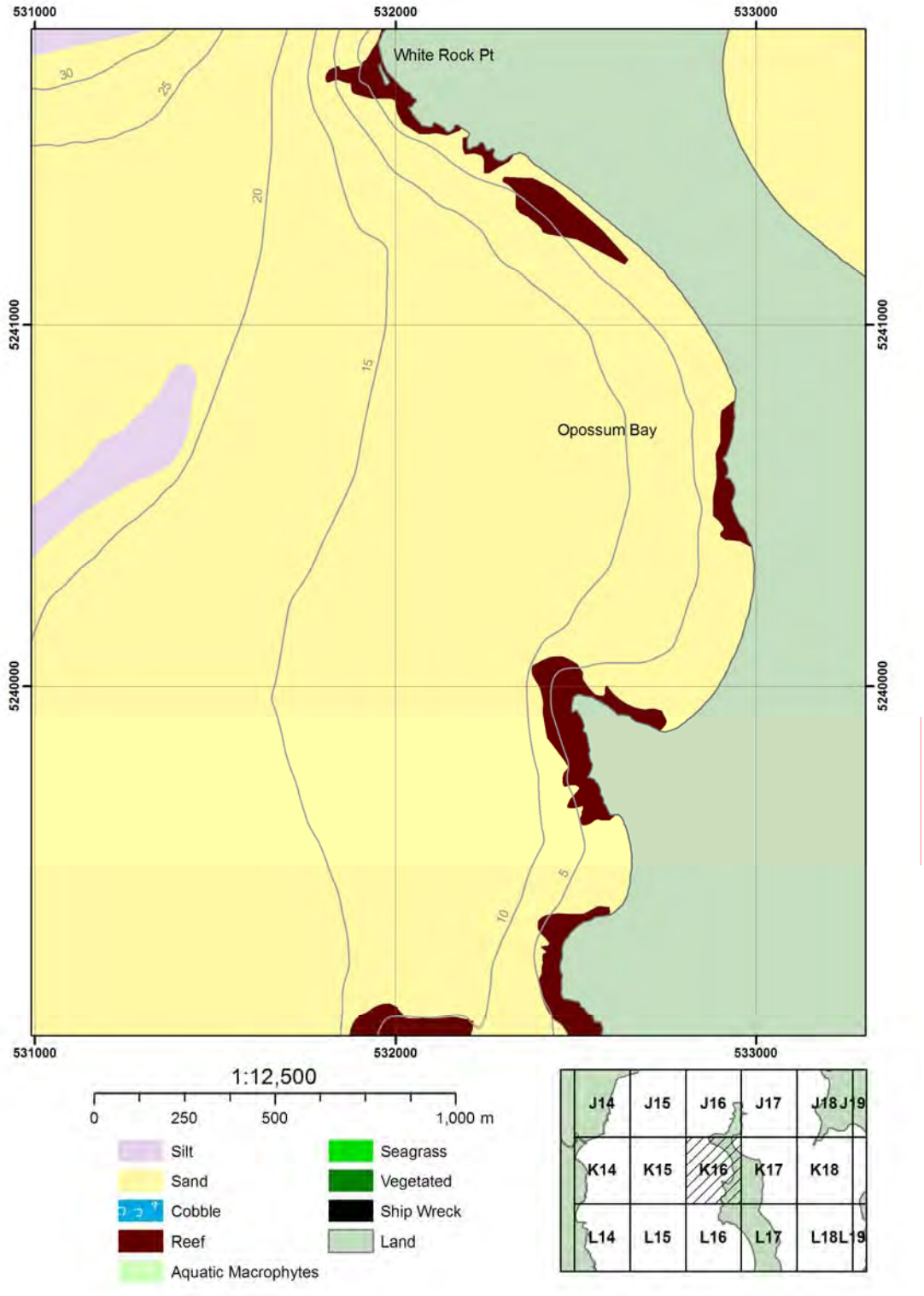
L16
L17
L18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White Rock Pt
Opossum Bay
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1:12,500
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250
500
1,000 m
Silt
Sand
Cobble
Reef
Aquatic Macrophytes
Seagrass
Vegetated
Ship Wreck
Land
J14
J15
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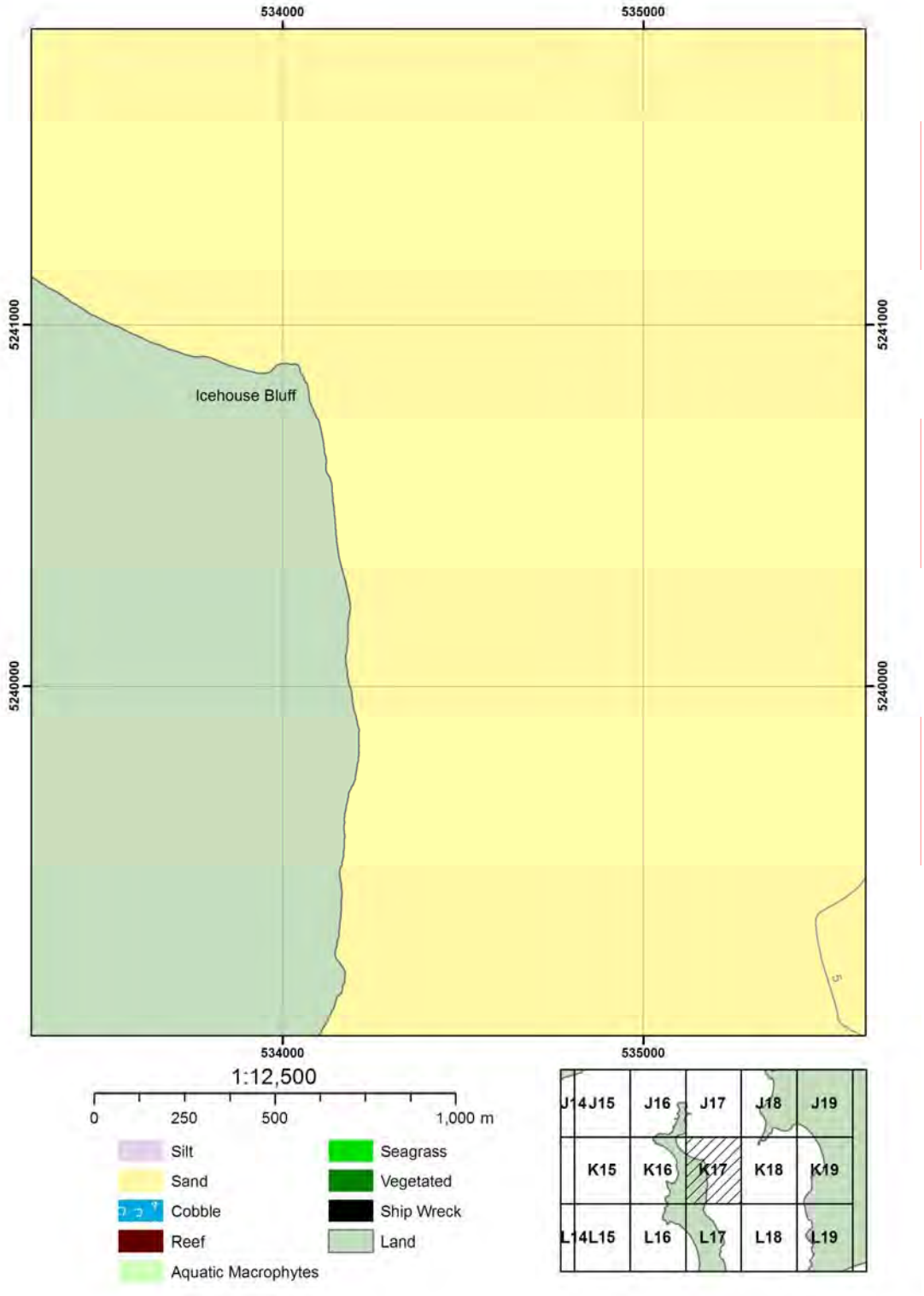
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Icehouse Bluff
1:12,500
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250
500
1,000 m
Silt
Sand
Cobble
Reef
Aquatic Macrophytes
Seagrass
Vegetated
Ship Wreck
Land
J14 J15
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L14 L15
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L17
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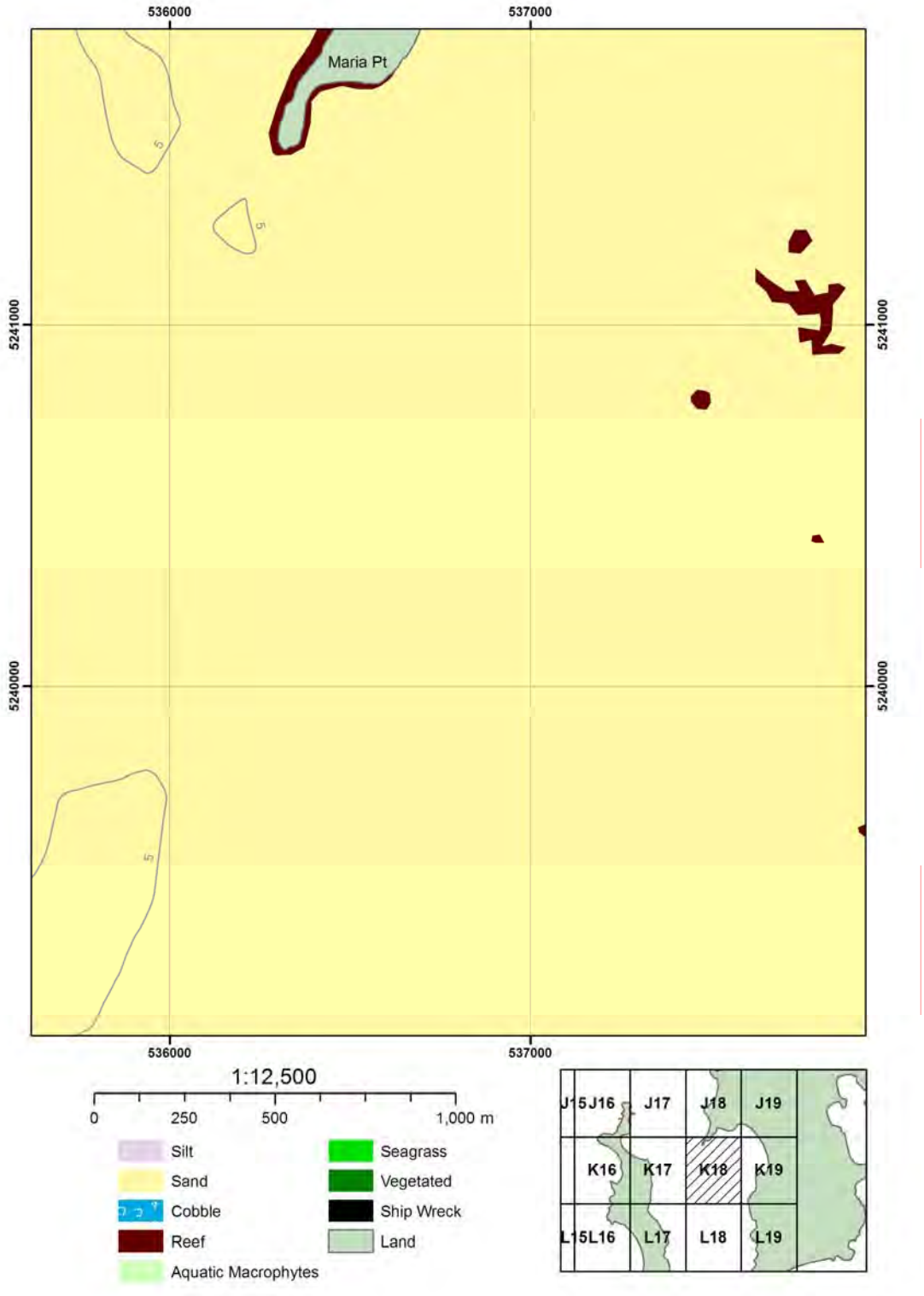
L19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Maria Pt
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500
1,000 m
Silt
Sand
Cobble
Reef
Aquatic Macrophytes
Seagrass
Vegetated
Ship Wreck
Land
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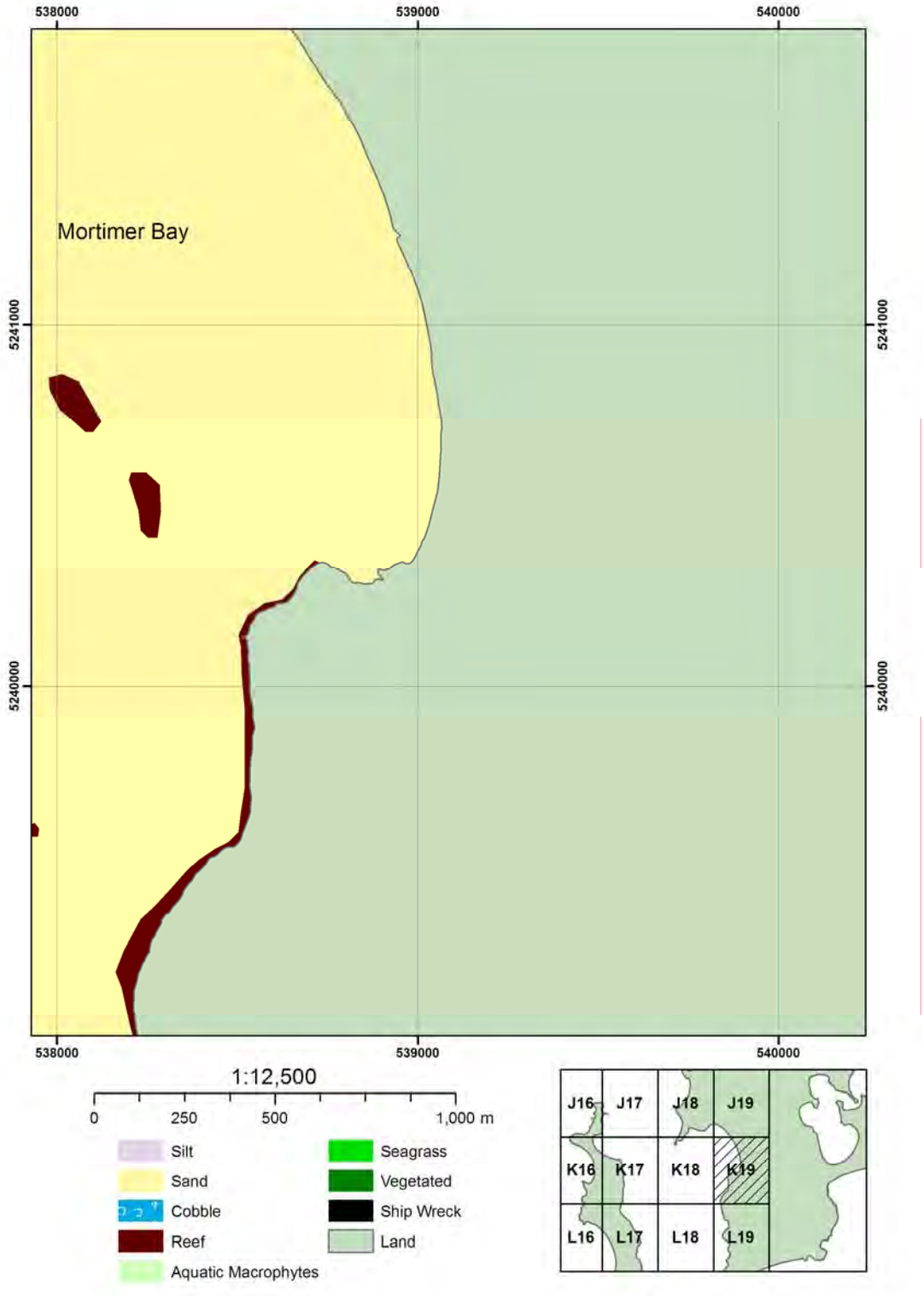
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Mortimer Bay
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500
1,000 m
Silt
Sand
Cobble
Reef
Aquatic Macrophytes
Seagrass
Vegetated
Ship Wreck
Land
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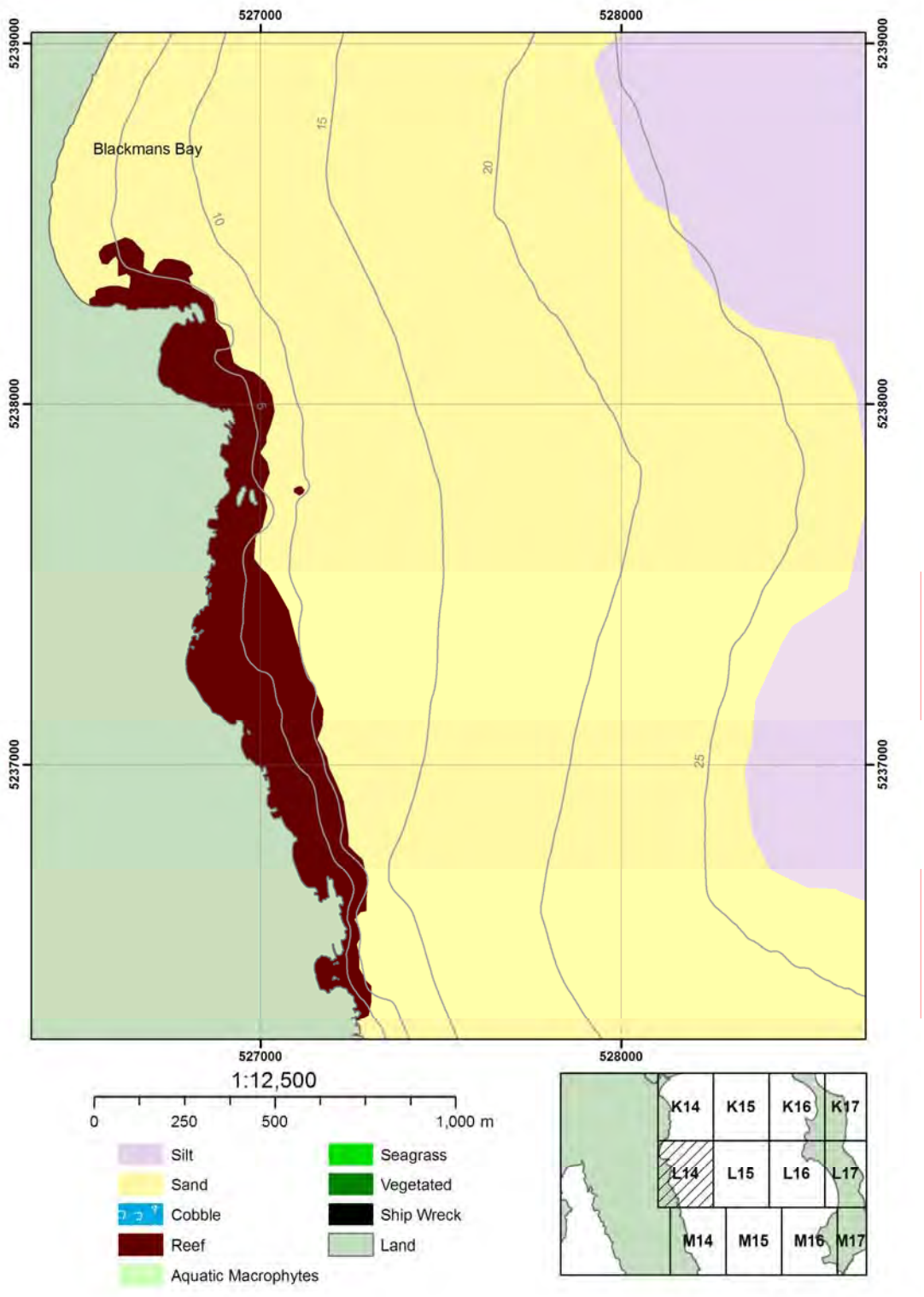
L19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5238000
5237000
Blackmans Bay
5
10
15
20
25
1:12,500
0
250
500
1,000 m
Silt
Sand
Cobble
Reef
Aquatic Macrophytes
Seagrass
Vegetated
Ship Wreck
Land
K14
K15
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M16
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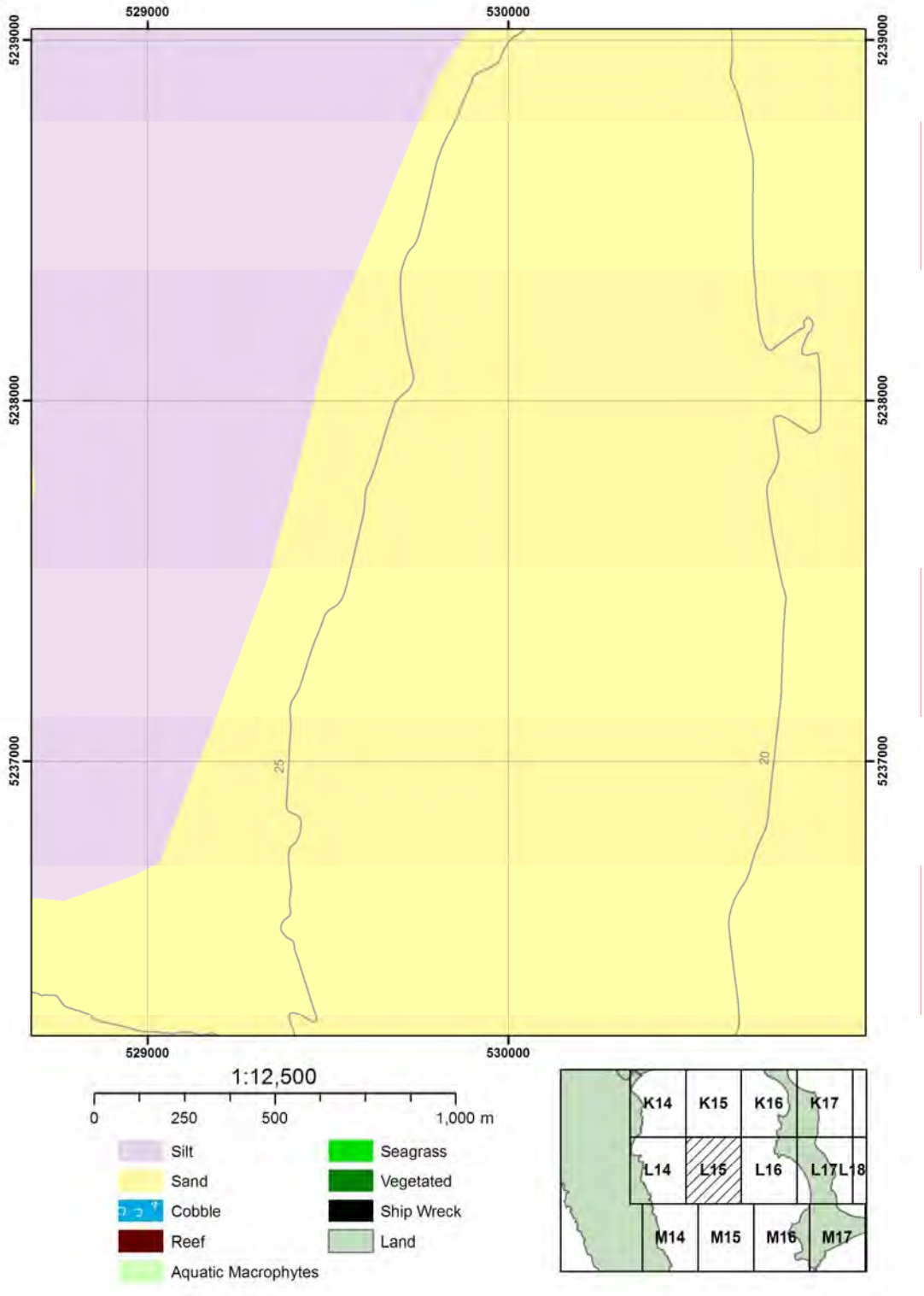
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530000
5239000
5238000
5237000
25
20
1:12,500
0
250
500
1,000 m
Silt
Sand
Cobble
Reef
Aquatic Macrophytes
Seagrass
Vegetated
Ship Wreck
Land
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L17
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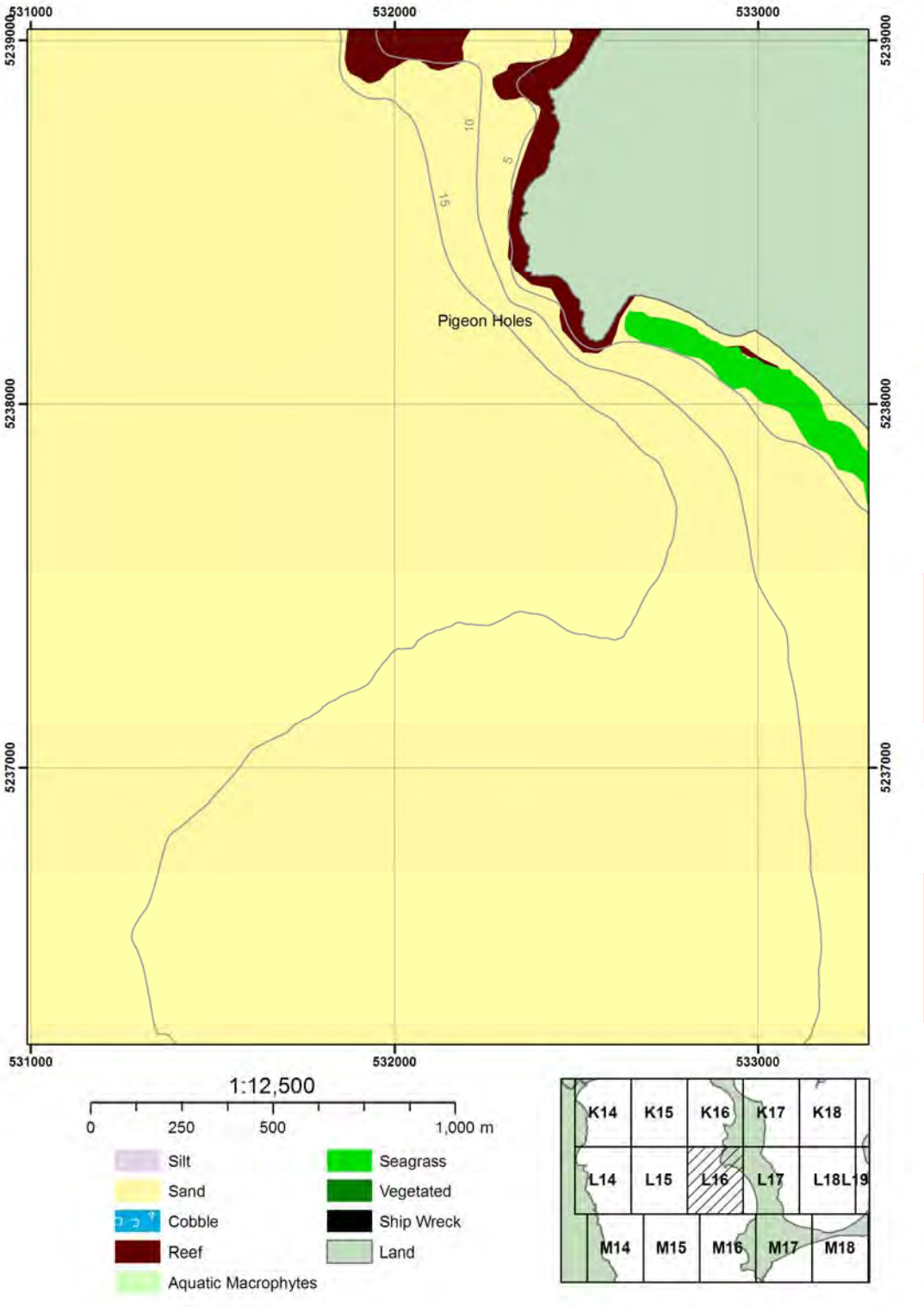
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5238000
5237000
Pigeon Holes
10
5
15
1:12,500
0
250
500
1,000 m
Silt
Sand
Cobble
Reef
Aquatic Macrophytes
Seagrass
Vegetated
Ship Wreck
Land
K14
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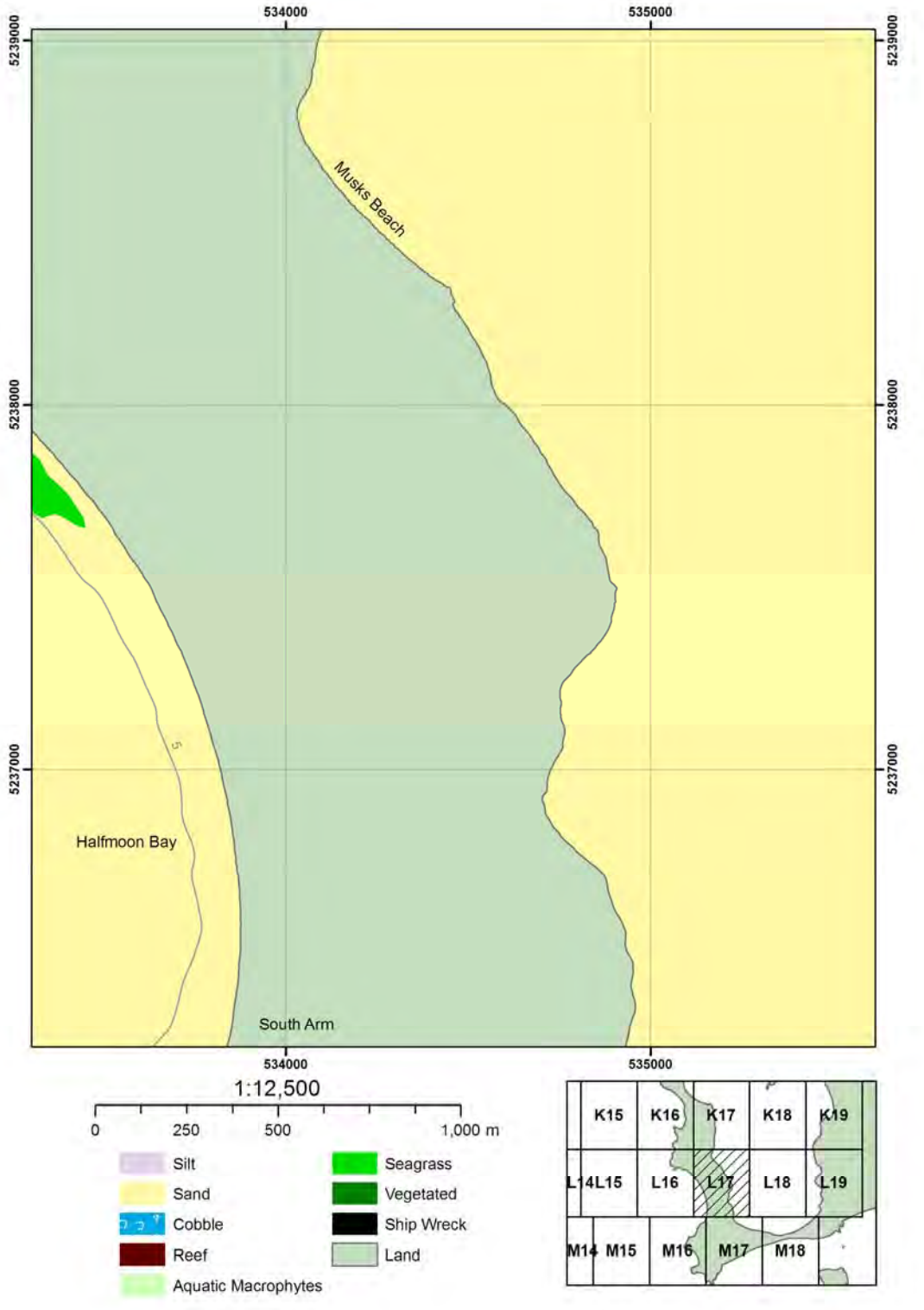
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5238000
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Musks Beach
Halfmoon Bay
South Arm
1:12,500
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250
500
1,000 m
Silt
Sand
Cobble
Reef
Aquatic Macrophytes
Seagrass
Vegetated
Ship Wreck
Land
K15
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L16
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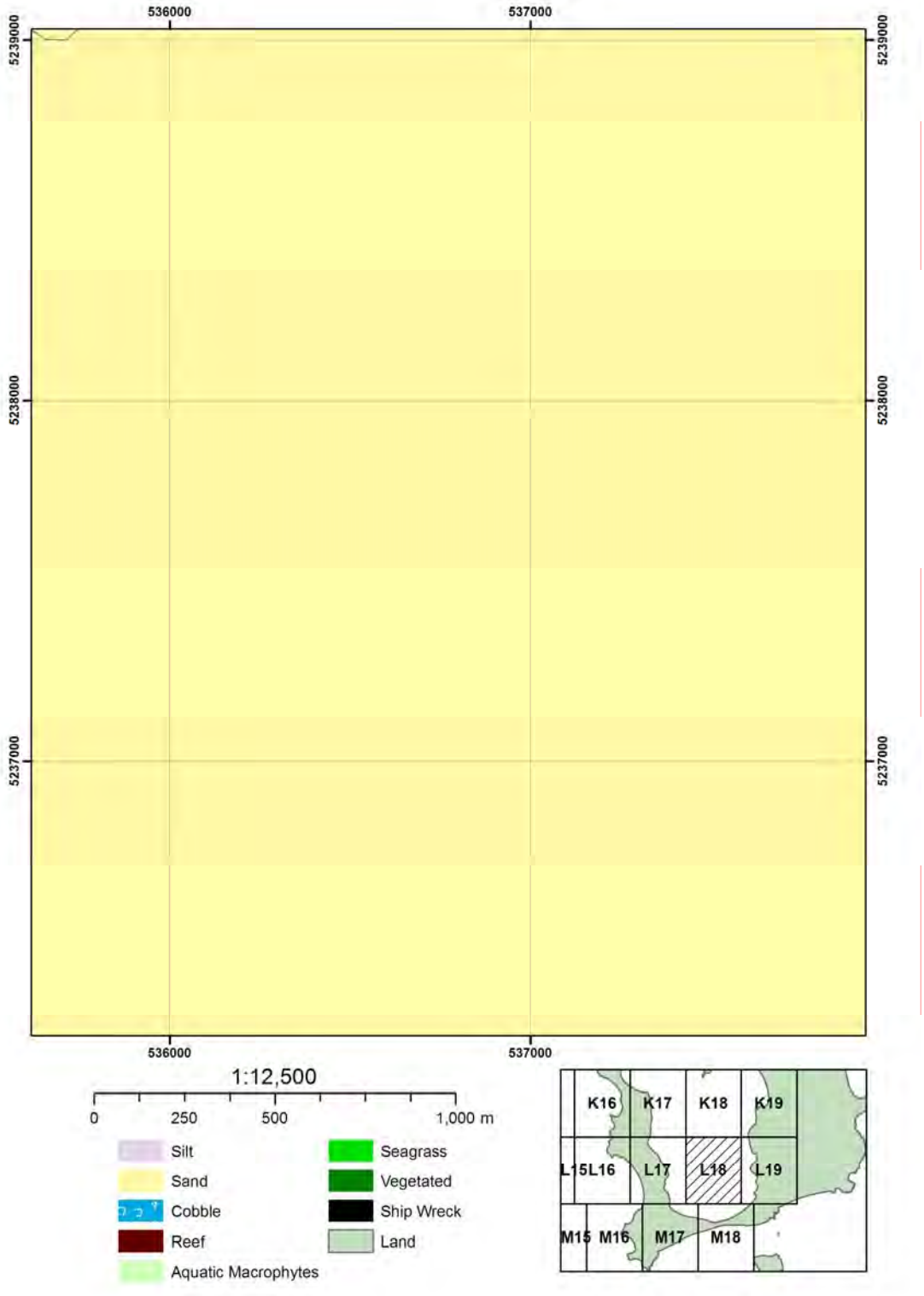
536000
537000
5239000
5238000
5237000
1:12,500
0
250
500
1,000 m
Silt
Sand
Cobble
Reef
Aquatic Macrophytes
Seagrass
Vegetated
Ship Wreck
Land
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K19
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M17
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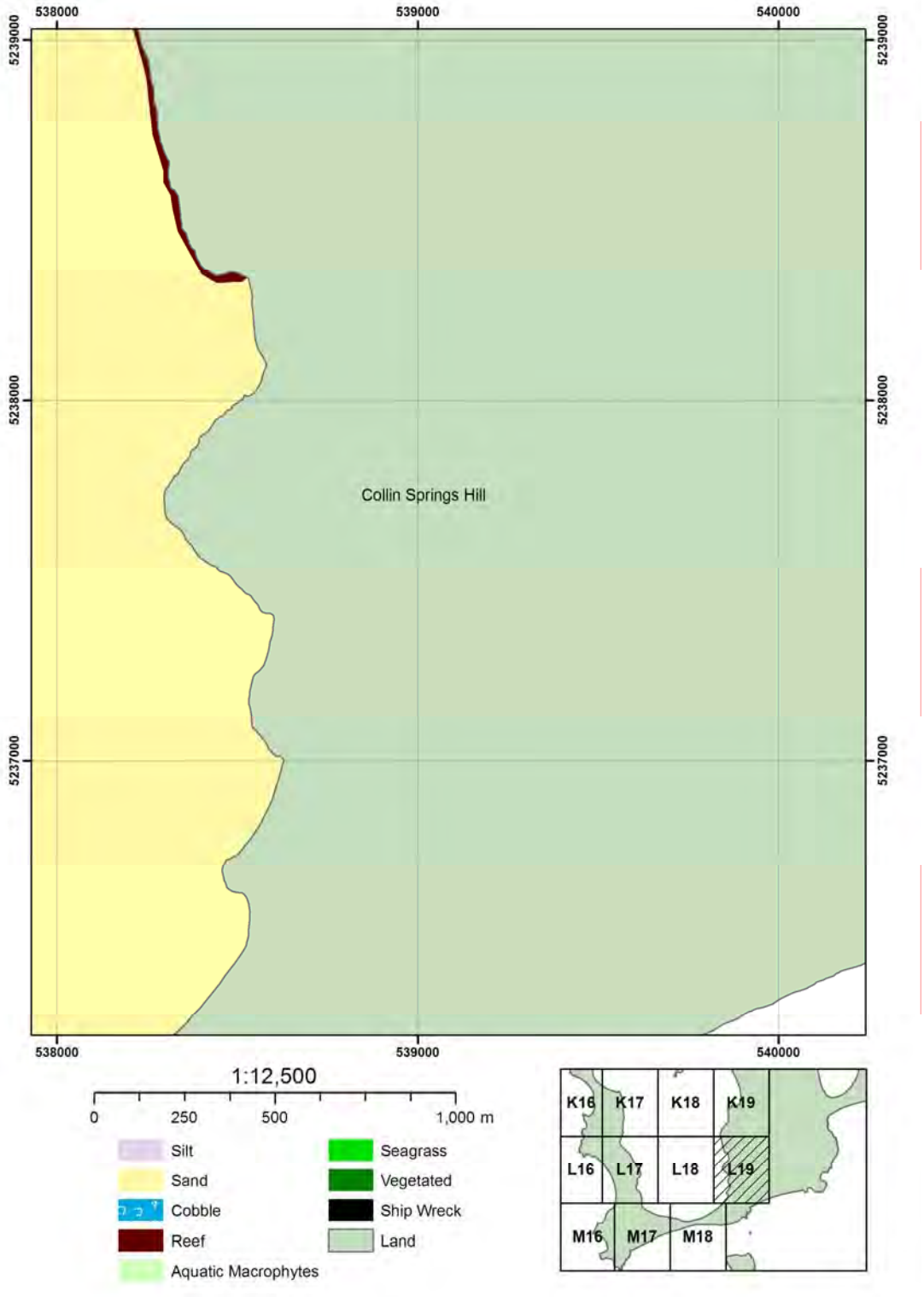
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540000
5239000
5238000
5237000
Collin Springs Hill
1:12,500
0
250
500
1,000 m
Silt
Sand
Cobble
Reef
Aquatic Macrophytes
Seagrass
Vegetated
Ship Wreck
Land
K16
K17
K18
K19
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L17
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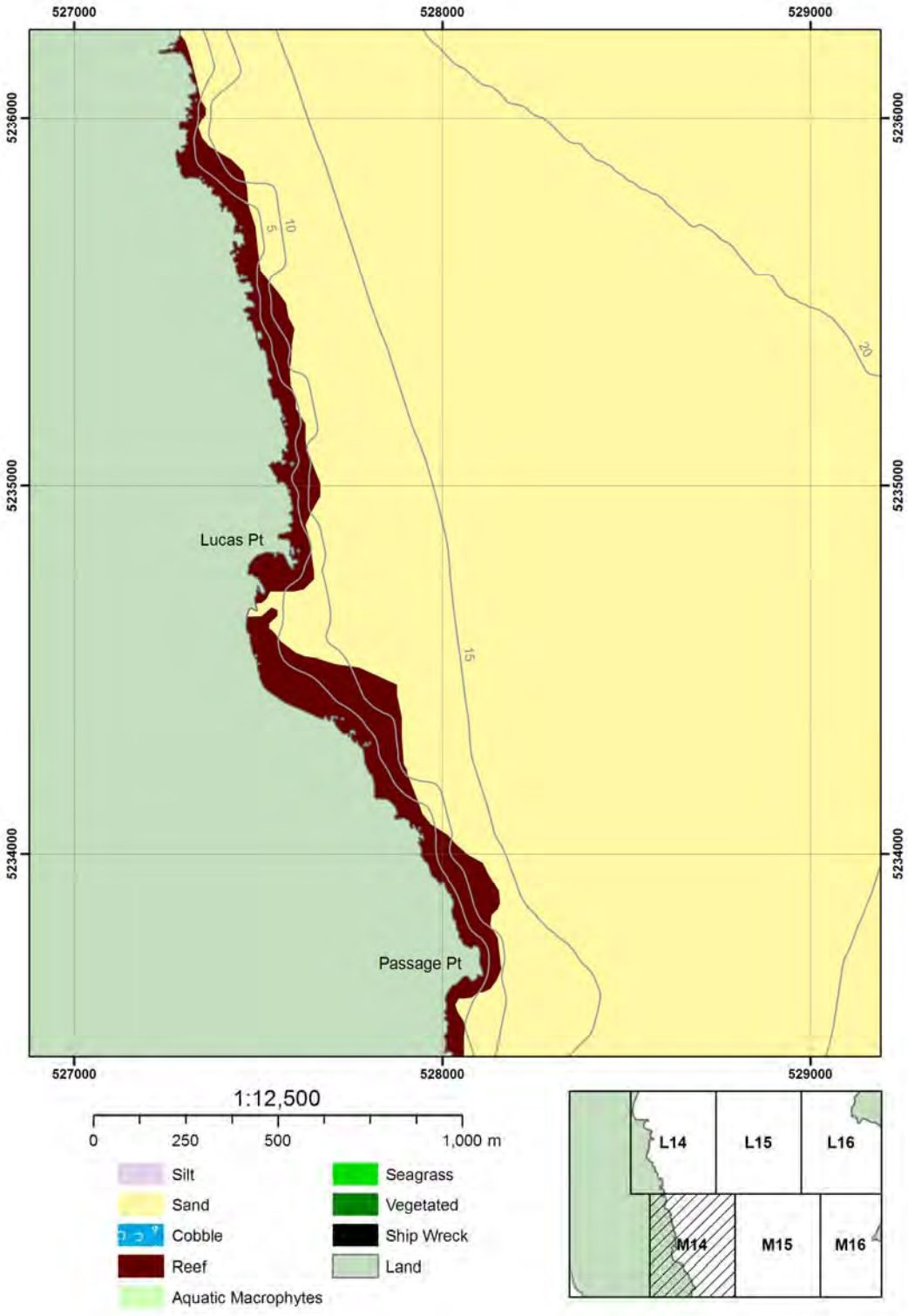
L19
M16
M17
M18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529000
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5234000
Lucas Pt
Passage Pt
10
5
15
20
1:12,500
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250
500
1,000 m
Silt
Sand
Cobble
Reef
Aquatic Macrophytes
Seagrass
Vegetated
Ship Wreck
Land
L14
L15
L16
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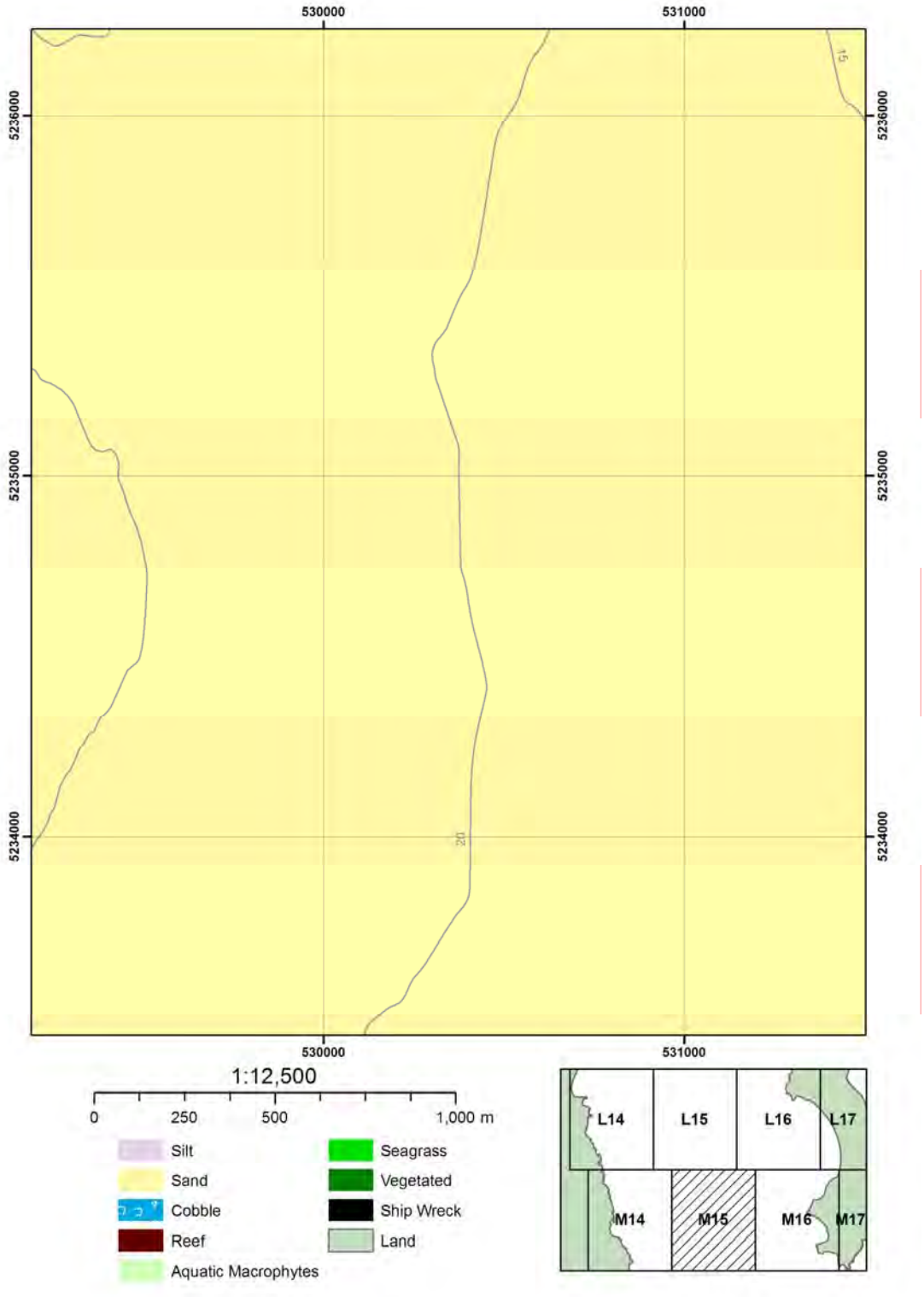
M15
M16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531000
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5235000
5234000
15
20
1:12,500
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500
1,000 m
Silt
Sand
Cobble
Reef
Aquatic Macrophytes
Seagrass
Vegetated
Ship Wreck
Land
L14
L15
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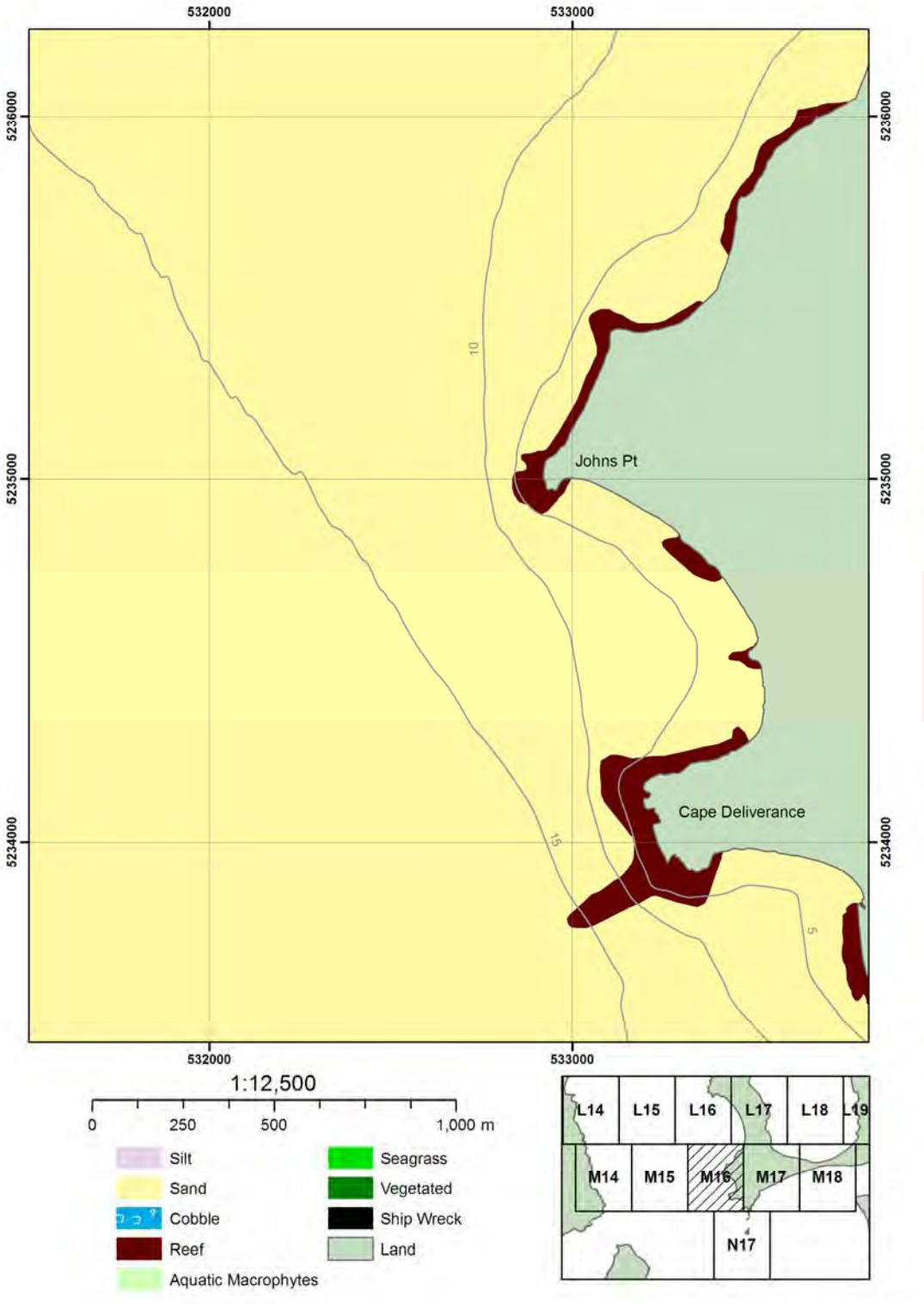
M17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Johns Pt
Cape Deliverance
10
15
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1:12,500
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1,000 m
Silt
Sand
Cobble
Reef
Aquatic Macrophytes
Seagrass
Vegetated
Ship Wreck
Land
L14
L15
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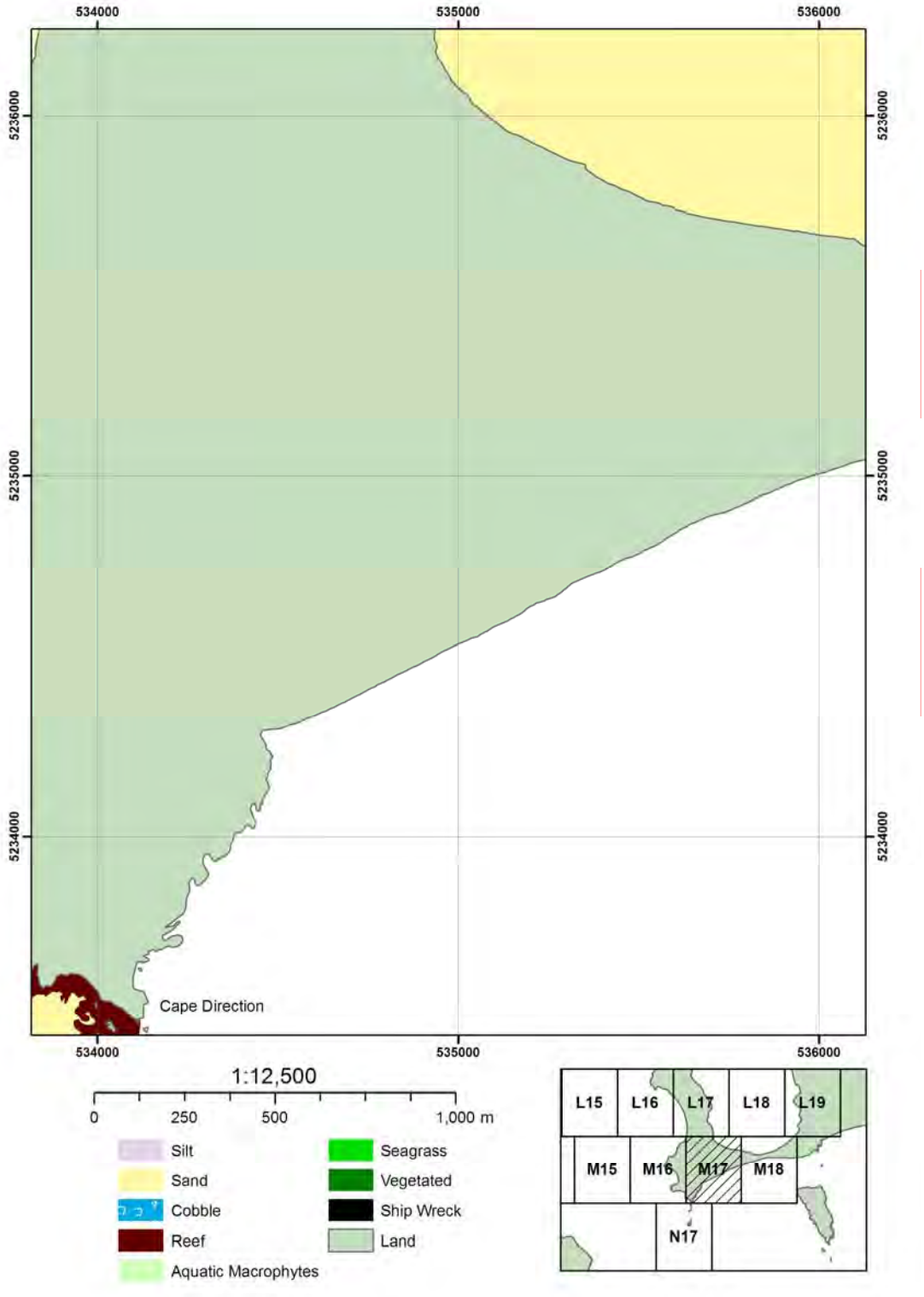
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Cape Direction
1:12,500
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250
500
1,000 m
Silt
Sand
Cobble
Reef
Aquatic Macrophytes
Seagrass
Vegetated
Ship Wreck
Land
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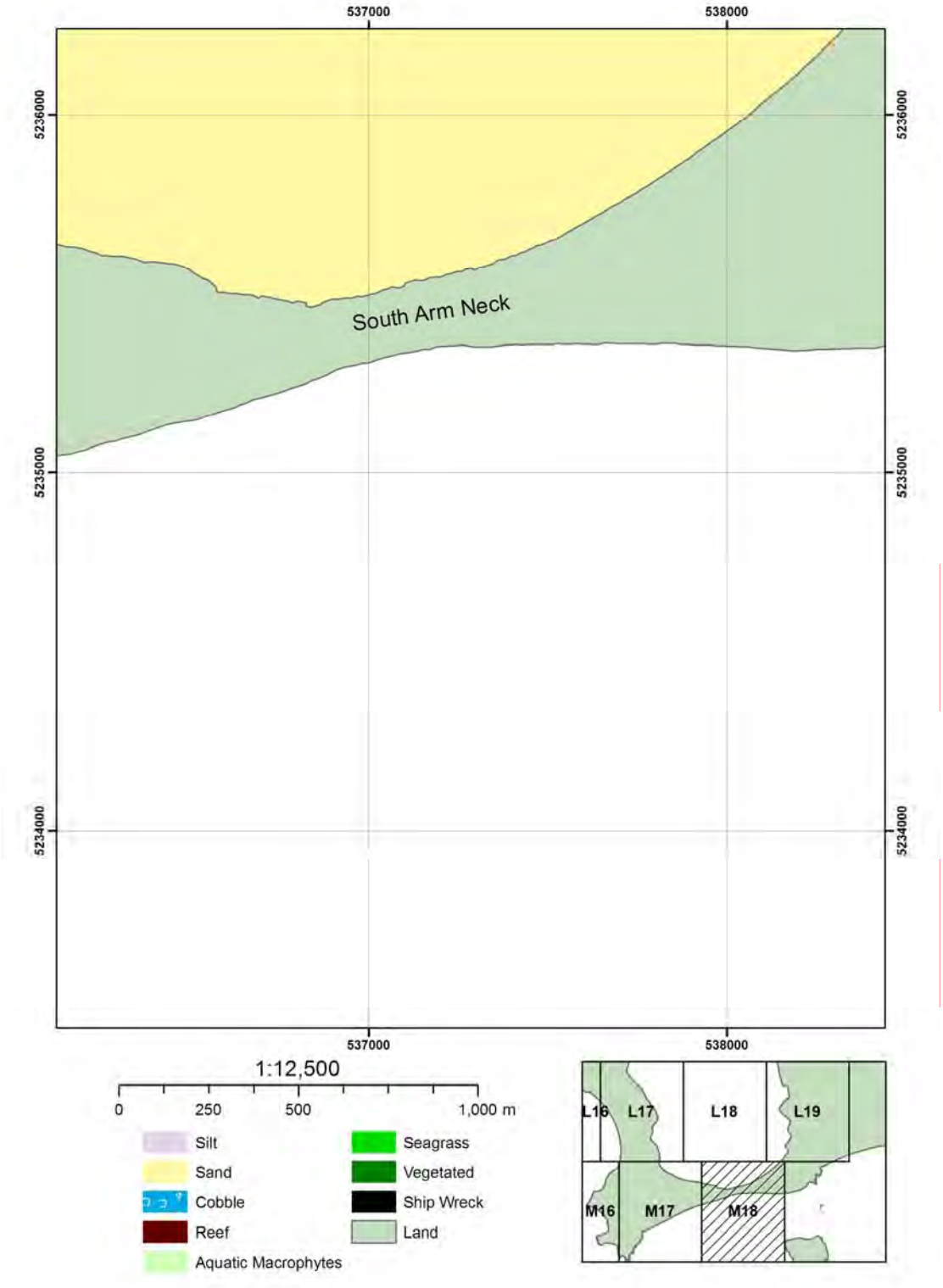
N17


537000
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South Arm Neck
1:12,500
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250
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1,000 m
Silt
Sand
Cobble
Reef
Aquatic Macrophytes
Seagrass
Vegetated
Ship Wreck
Land
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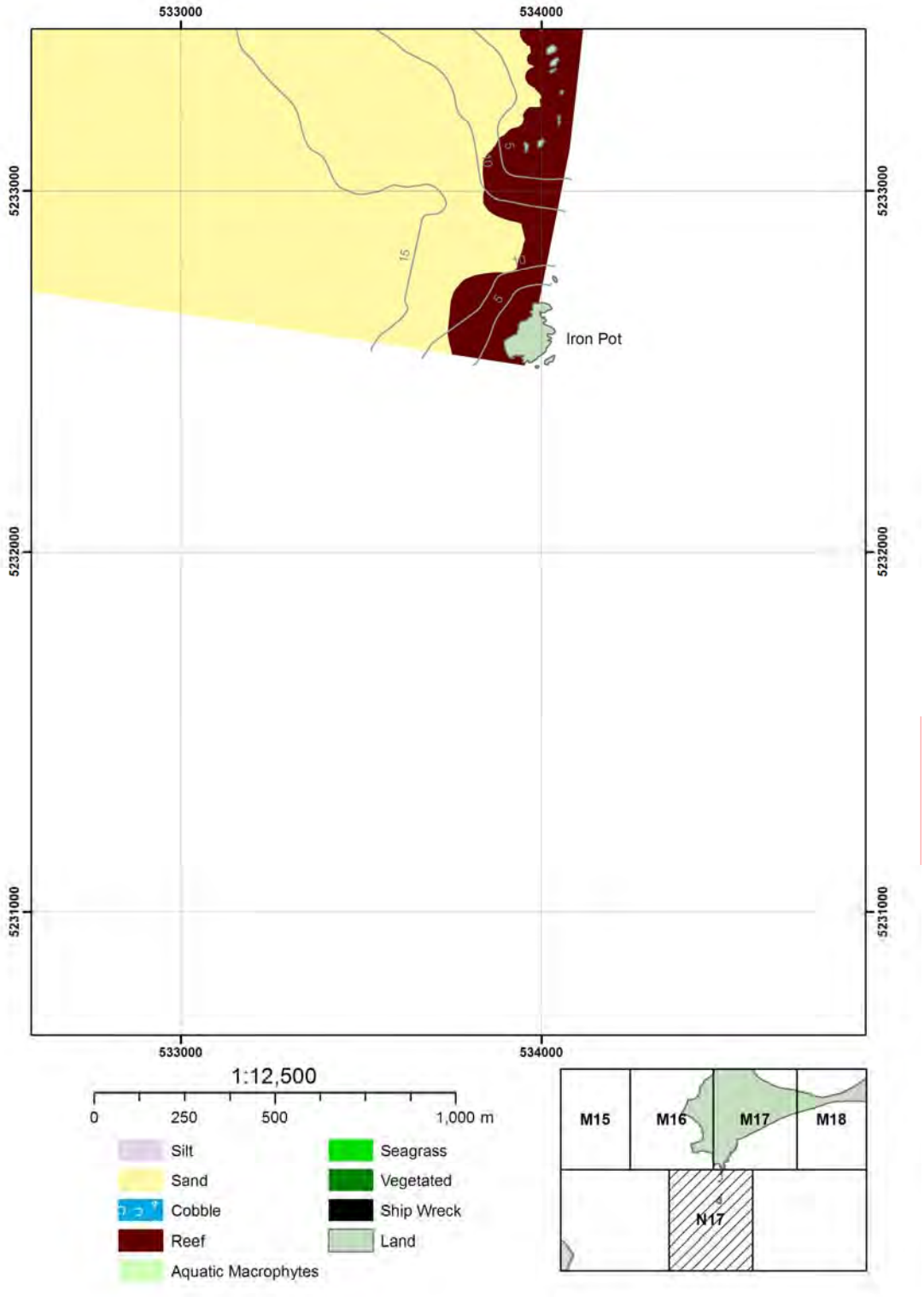
M18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5231000
Iron Pot
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0
250
500
1,000 m
Silt
Sand
Cobble
Reef
Aquatic Macrophytes
Seagrass
Vegetated
Ship Wreck
Land
M15
M16
M17
M18
N17

4. Conclusions

A resurvey of the distribution of marine habitats of the Derwent Estuary was conducted from April to June 2007 by SeaMap Tasmania. The initial habitat mapping survey was completed in 2001 by Jordan et al (2001) as part of a NHT project (CMP22338) focusing on the integration of science and management for the development of a monitoring program for the Derwent Estuary.

Comparisons have not been made between the results of this survey and the initial mapping report due to the temporal and technical difficulties in detecting change in benthic marine habitats. Single beam acoustics do not have a high degree of signal fidelity which is due to a number of parameters and this makes comparison between results over different seasons, sea conditions and between different acoustic sounders impossible.

The distribution of several habitat classes have been presented and discussed in this report. The image mapper product and shapefiles attached in Appendices 3 and 4 are for the discrete use of the Derwent Estuary Program and remain the copyright of the Tasmanian Aquaculture and Fisheries Institute. The results of this survey provide natural resource managers, industry and the community with the information needed to contribute to biodiversity conservation and natural resource management of the Derwent Estuary. It provides further information needed to define and measure marine habitat extents in Tasmanian waters and increases our knowledge to improve impact assessments to protect the health and condition of sub tidal marine habitats.

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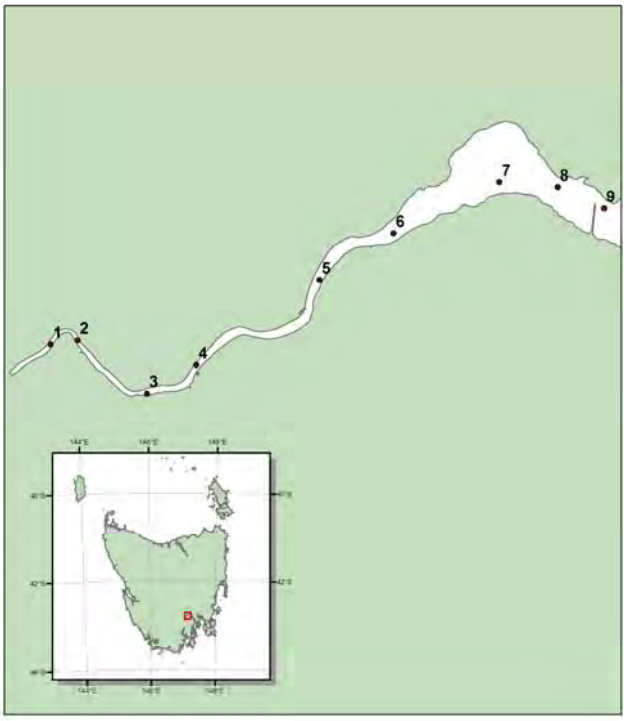
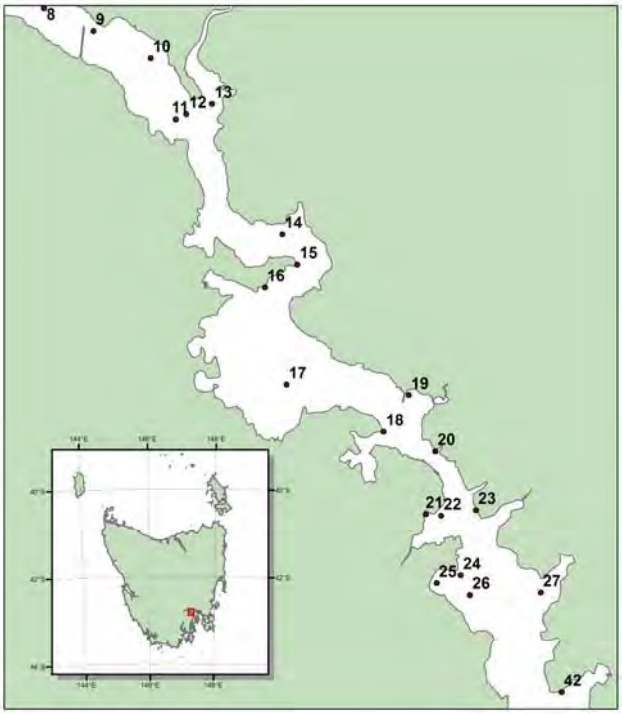
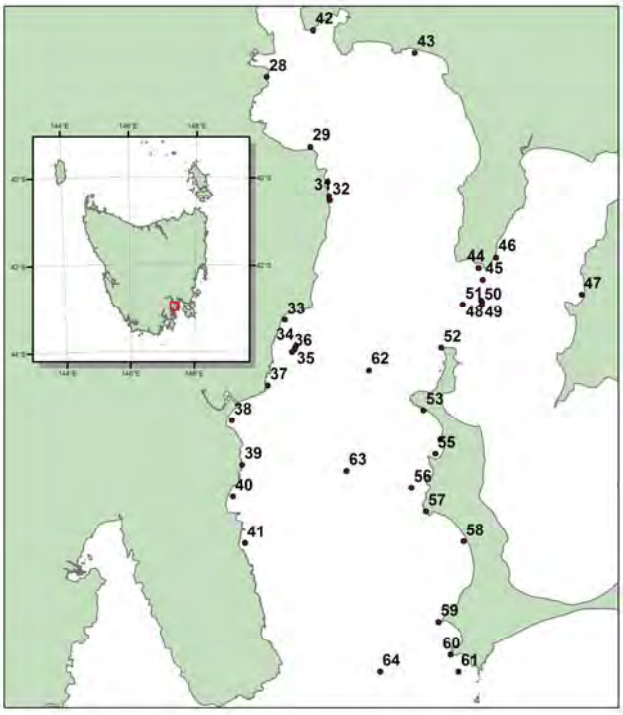
Appendix 1: Video Transect Locations

Appendix 1 outlines the location of individual video drops conducted within the estuary and the ID numbers correspond to the site descriptions in Appendix 2.







Appendix 2: Video Transect Descriptions

Video ID #	Video Name	Latitude	Longitude	Depth	Observation
V01	UD_20070529_V08	-42.77292	147.06818	5 - 7 m	Reef with thick silt covering, occasional submerged logs. Some small unidentifiable fish
V02	UD_20070529_V07	-42.77205	147.07590	6 - 8 m	Silt with some reef patches. No algal growth. Some small unidentifiable fish possibly *Pseudaphritis urvili*
V03	UD_20070529_V06	-42.78324	147.09600	6 - 7 m	Reef with patches of silt. Very little light penetrating the upper layers of the water column. No algal growth and few signs of fauna, some unidentifiable fish
V04	UD_20070529_V05	-42.77724	147.11022	5 - 7 m	Silt, with bacterial mat in deeper water
V05	UD_20070529_V04	-42.75899	147.14580	5 - 6 m	Silt
V06	UD_20070529_V03	-42.74918	147.16709	0.5 - 6 m	Silt onto a sparse bed of seagrass (*Heterozostera tasmanica*)
V07	UD_20070529_V02	-42.73807	147.19770	0.5 - 6 m	Silt onto a sparse bed of seagrass (*Heterozostera*). Seagrass with large amount of associated brown algae
V08	UD_20070529_V01	-42.73913	147.21447	0.5 - 5 m	Silt onto *Ruppia* sp.
V09	MD_20070529_V18	-42.74370	147.22788	1 - 6 m	Silt with a small amount of fine shell grit, a few patches of seagrass (*Heterozostera*) with long blades. Dense seagrass bed at end of transect
V10	MD_20070529_V17	-42.74906	147.24341	1 - 3 m	Dense *Heterozostera* with long blades. Sediment fine silt with some small burrows
V11	MD_20070529_V16	-42.76133	147.25023	1 - 2 m	Silt with some seagrass (*Heterozostera*) and large amounts of epiphyte and associated algae
V12	MD_20070529_V15	-42.76029	147.25316	3 - 4 m	Silt with few features
V13	MD_20070529_V14	-42.75829	147.26010	1 - 2 m	Seagrass with large amount sediment cover. Relatively long blades and some patches of epiphyte growth
V14	MD_20070529_V13	-42.78422	147.27932	1 - 3 m	Silt with oysters growing on it onto seagrass (*Heterozostera*)
V15	MD_20070529_V12	-42.79023	147.28340	2 m	Silt with oysters onto seagrass (*Heterozostera*). Some *Patiriella* sea stars observed
V16	MD_20070529_V11	-42.79482	147.27460	1 - 14 m	Silt with lots of shell grit onto oyster beds with some seagrass in shallow (*Heterozostera*). *Asterias* is found here on the silt and oysters
V17	MD_20070529_V10	-42.81433	147.28056	3 m	Silt with lots of burrows. Some mollusc tracks, little visible fauna
V18	MD_20070529_V08	-42.82375	147.30699	3 - 7 m	Silt with large amounts of dead oyster shell onto reef with some living oyster. Both sea stars *Asterias* and *Patiriella* are found here along with some *Myxicola* polychaete
V19	MD_20070529_V09	-42.81637	147.31382	0.5 - 3m	Silt onto reef with oyster and *Asterias* sea star. The reef has sparse algal cover of mainly red algae. The silt has some *Asterias* and *Patiriella* sea stars
V20	MD_20070529_V07	-42.82766	147.32107	1 - 15 m	Silt onto reef with dense population of oysters. The sea star *Patiriella* is found

					on the silt here, while *Astrerias* is on the reef
V21	MD_20070529_V05	-42.84026	147.31859	1 - 2 m	Silt onto seagrass (*Heterozostera sp.*) The sea star *Patiriella sp.* occurs on the silt at this location
V22	MD_20070529_V06	-42.84057	147.32276	2 - 6 m	Barren reef with light cover of red alga onto silt. Both sea stars *Patiriella* sp. and *Asterias* sp. are on both the reef and silt
V23	MD_20070529_V04	-42.83940	147.33216	4 - 19 m	Silt up to reef at the base of Bedlam Walls. *Asterias* is present on the silt and reef. The sea star *Patiriella* sp. is also present on the reef. Little algal growth on the reef with only sparse red alga and turfing browns
V24	MD_20070529_V03	-42.85253	147.32810	3 - 6 m	Silt with oyster shells on to cobbly reef with *Asterias*. The silt is densely populated with *Myxicola* sp. polychaete. The reef has limited algal growth with only turfing browns and some red algae
V25	MD_20070529_V02	-42.85410	147.32160	1 m	Cornelian Bay. Seagrass bed (*Heterozostera* sp.) Some sea stars (*Asterias* sp.) present
V26	MD_20070529_V01	-42.85645	147.33063	6 - 9 m	Silt with lots of filamentous brown algae. The sea star *Asterias amurensis*. and the polychaete *Myxicola* sp. are present
V27	MD_20070524_V01	-42.85590	147.34991	10 m	Silt with many small to medium burrows, a few *Asterias*
V28	MD_20070529_V19	-42.88881	147.33865	4 - 8 m	Silt with shell grit, a few rocks and tyres. Numerous burrows and *Myxicola* fan worms on sediment in deeper water, *Asterias* and *Patiriella* sea stars also present
V29	SB_20070509_V01	-42.90786	147.35482	3 - 9 m	Sand with patches of algal growth including filamentous red/brown and *Ulva*. Numerous *Asterias*, small burrows and *Myxicola* sp. polychaete fan worms
V30	TR_20070509_V03	-42.91737	147.36124	3 - 5 m	Dense *Heterozostera* with relatively short blades, and associated mixed red algae and *Ulva*. Sand generally bare leading into reef with *Cystophora*, mixed red algae
V31	TR_20070509_V02	-42.92127	147.36179	2 - 5 m	Dense *Heterozostera* with some *Cystophora* and mixed red algae. Into patchy reef with low cover of *Ecklonia*, *Cystophora* and mixed red algae
V32	TR_20070509_V01	-42.92248	147.36210	2 - 7 m	Dense *Heterozostera tasmanica* to 4 m depth, becoming sparse to 6 m. Occasional patches of reef amongst seagrass with *Ecklonia*, *Cystophora*, *Caulocystis*, *Sargassum*, mixed red algae and *Ulva*
V33	KB_20070504_V04	-42.95516	147.34573	2 - 5 m	Reef comprising barren sand scoured rocks on sand edge in shallow water. In deeper water algal cover includes *Caulerpa* and mixed red algae in patches, with increasing amounts of *Cystophora*, C*arpoglossum*, *Acrocarpia*

					and *Ecklonia*. Small amounts of *Codium* sp., some *Undaria pinnaitifida*
V34	KB_20070504_V03	-42.96227	147.34967	13 - 14 m	Bare sand with a few New Zealand screw shells, moving onto low relief reef. Algal cover low to medium, with a combination of *Ecklonia*, mixed red algae, *Cystophora* and *Acrocarpia*. Some coralline algae and the occasional sponge
V35	KB_20070528_V01	-42.96325	147.34930	14 m	Sand with fine shell grit, some patchy reef with *Ecklonia* and coralline algae
V36	KB_20070528_V02	-42.96386	147.34836	12 - 14 m	Reef with little algal cover, small patches of coralline algae, majority covered with invertebrate sediment matrix, a small amount of *Ecklonia* also present. Numerous *Asterias* and dead screw shells within reef structure. Sand with fine shell grit and numerous *Asterias*
V37	KB_20070504_V02	-42.97290	147.33944	4 - 10 m	Reef with a dense algal cover in shallow water decreasing with depth to become relatively barren at depth. In less than 5 m algae dominated by a mix of *Cysophora* sp. and *Acrocarpia* sp., with small amounts of *Lessonia corrugata* and *Ecklonia radiata* on more exposed rocks and ledges. Small amounts of mixed red algae and *Ulva sp.* also present in the shallow depth range. *Carpoglossum confluens* more common in 5 – 6 m. Below 6 m algae becoming more sparse with a mix of red algae, occasional *Undaria pinaitifida* plant, and the stalked ascidian *Pyura* sp. Below 7.5 m generally barren with occasional tufts of red algae and *Undaria*. Light sediment cover on deeper reef with a few sponges on deep reef margin. Occasional New Zealand screw shell (*Maoriculpus roseus*) on reef
V38	KB_20070504_V01	-42.98252	147.32622	2 - 6 m	Bare sand with ripples
V39	KB_20070504_V05	-42.99483	147.33010	3 - 6 m	Reef comprising large boulders with mixed algal cover. Major components of the algal community include mixed red algae, *Ulva*, *Cystophora*, *Ecklonia*, *Acrocarpia*, and *Lessonia*. Small amounts of *Undaria* and *Sargassum* were also present as was the stalked ascidian *Pyura* sp.
V40	KB_20070504_V06	-43.00333	147.32674	3 - 7 m	Bare sand with ripples, some shell grit
V41	KB_20070504_V07	-43.01624	147.33125	5 - 6 m	Reef with a mixed algal community including *Carpoglossum*, *Acrocarpia*, *Ecklonia*, *Caulerpa*, *Cystophora* and mixed red algae. *Macrocystis pyrifera* also present
V42	SB_20070509_V02	-42.87604	147.35570	2 - 7 m	Reef with a mix of *Ecklonia*, *Ulva*, *Acrocarpia*, *Codium* and coralline algae in depths less than 3 m. Below 3 m substrate a mix of barren rocks and shell. Small amount of mixed red algae and also *Myxicola* worms. Below 5 m depth

					more consistent rock with occasional mixed red algae and a small amount of *Ecklonia* and *Undaria*
V43	BR_20070510_V01	-42.88202	147.39317	3 - 6 m	Sand with patches of shell and shell grit. Some patches of mixed red algae and a small amount of *Codium*. A few *Myxicola* sp. polychaete worms and numerous *Asterias amurensis*
V44	RB_20070417_V01	-42.94058	147.41709	2 - 15 m	Reef with *Ecklonia* and *Cystophora* in 2 - 2.5 m. Sparse algae below 2.5 m mainly mixed red algae, *Ulva*, *Ecklonia* and *Codium*. Very little algae below 5m. A few sponges below 7 m and some dead New Zealand screw shells
V45	RB_20070501_V01	-42.94383	147.41867	15 - 20 m	*Silt with occasional sponge. Finger sponge and zoanthids on bridge section. Some New Zealand screw shells on sediment and Holothurians*
V46	RB_20070501_V04	-42.93782	147.42348	2 - 13 m	Reef to 3 m depth, with *Codium*, filamentous brown and red algae. Sand below 3m with a mixture of fan worms, *Asterias*, *Ulva*, cunjevoi (*Pyura* sp.), mixed red algae and *Codium*. Burrows in deeper water
V47	RB_20070417_V03	-42.94777	147.45517	1 - 4 m	Sand with *Asterias* and fan worms
V48	RB_20070501_V03	-42.94954	147.41807	11 - 13 m	Barren rock with some sponge and occasional patches of coralline algae. *Asterias*, New Zealand screw shells, holothurians and fan worms (*Myxicola* sp.) present
V49	RB_20070501_V02	-42.94995	147.41850	13 - 14 m	Silt with fan worms (*Myxicola* sp.), dead New Zealand screw shells and *Asterias* sp.
V50	RB_20070417_V02	-42.95091	147.41829	14 - 17 m	Silt with *Asterias* and New Zealand screw shells. Lots of burrows in deeper parts
V51	RB_20070514_V01	-42.95071	147.41129	20 m	Silt with burrows
V52	OP_20070514_V01	-42.96260	147.40341	1 - 7 m	Reef with *Ecklonia*, *Cystophora* and mixed red algae in less than 2 m depth. In 2 - 3 m depth occasional patches of *Ecklonia* and mixed red algae, and lesser amounts of *Cystophora* and *Codium* Sediment below 3m with *Asterias*, Cunjevoi and some *Myxicola sp.* fan worms
V53	OP_20070528_V01	-42.97950	147.39699	3 - 6 m	Sand with light cover of diatoms. Patches of cobble with some filamentous red alga. More extensive patches of cobble also with small amounts of *Cystophora*, *Carpoglossum* and *Zonaria* but generally barren. Occasional dead screw shell
V54	OP_20070528_V02	-42.98761	147.40323	3 - 6 m	Small band of *Heterozostera tasmanica* on edge of reef. Reef generally barren with some *Cystophora* and mixed red algae. Moving into sand with some sparse seagrass and diatom cover
V55	OP_20070528_V03	-42.99154	147.40145	2 - 6 m	Sand substrate with a small amount of

					dead cockle shell. Patches of *Heterozostera* with light epiphyte and associated algae, including filamentous red algae and *Ulva*. Light diatom growth on sediment, and some Cunjevoi. Numerous *Asterias* in deeper areas
V56	OP_20070528_V04	-43.00080	147.39269	7 - 12 m	Reef covered with sediment and invertebrate matrix in deeper parts and small amounts of coralline and red algae. In shallower water *Ecklonia* dominates with small amount of filamentous red algae and *Carpoglossum*. Sand patches with fine shell grit and some dead screw shell in gutters. Sand on outer margin with *Asterias*
V57	OP_20070528_V05	-43.00722	147.39804	2 - 6 m	Reef with dense cover of *Ecklonia* in shallow. Coralline, mixed red algae, *Cystophora* and *Ulva* also present. Rapidly onto sand with a few sparse blades of *Heterozostera*
V58	SA_20070528_V01	-43.01552	147.41204	2 - 5 m	Sand with sparse *Heterozostera*, some associated filamentous red algae. Some *Myxicola* fan worms amongst seagrass and light diatom cover
V59	SA_20070528_V02	-43.03738	147.40287	3 - 10 m	Reef with dense *Carpoglossum*, mixed red algae, *Ecklonia Ulva*, *Acrocarpia*, *Cystophora* and *Sargassum*. Into sand with patches of shell grit and cunjevoi
V60	SA_20070528_V03	-43.04640	147.40748	3 - 8 m	Reef with *Acrocarpia*, mixed rad algae, *Carpoglossum*, *Cystophora*, *Ecklonia*. *Carpoglossum* more dominant on deeper reef. Bare sand on outer margin of reef
V61	SA_20070528_V04	-43.05107	147.41041	13 m	Bare sand with small amount of shell grit, into patches of dense shell grit
V62	LD_20070528_V03	-42.96873	147.37680	20 - 34 m	Silt with fine shell grit and numerous New Zealand screw shells. A few tracks in sediment. Some *Asterias*
V63	LD_20070528_V02	-42.99637	147.36867	30 m	Silt with a few small burrows and occasional small patches of filamentous algae. *Asterias*
V64	LD_20070528_V01	-43.05116	147.38145	16 m	Bare sand with some shell grit. Some *Asterias*

Appendix 3. Image Mapper CD

The Image Mapper CD located at the back of this report links the marine habitat maps and contours with all of the video files recorded.

Appendix 4. Derwent 2007- Habitats and Bathymetry

CD 2 located at the back of this report contains the ESRI shapefiles for the habitats and bathymetry of the Derwent Estuary in MGA94 Zone 55 projection. These shapefiles are for the exclusive use of the Derwent Estuary Program. The metadata for these data layers is inclusive on the CD.